

by GODFREY FOO

Making wood durable and stable through heat treatment

There is so much talk about heat treatment of wood, but few in Asia really understand this technology and are not fully aware of the business threat it poses to tropical hardwoods.

The movement towards heat-treated wood

Tropical hardwoods such as Merbau, Kapur, Teak, Changai, Kempass and Ulin are very hard and durable. They are expensive, in demand and getting very scarce. There are many environmental groups (such as World Wildlife & Forest Organisation) and governments that are opposed to the cutting down of these tropical timbers.

In Europe, as well as in USA and Canada, there is a rush to build heat treatment plants, to make heat treated wood. In Europe, there is THERMOWOOD (a Finnish Trademark). Almost all temperate climate woods, such as Ash, Beech, Birch, Pine, Cedar, Oak, Spruce, Larch, and many others can be heat treated to make them more durable and stable as compared to tropical hardwoods. The colour change of heat treated to a deep brown color is not at the surface, it is uniform throughout the entire cross section.

Impregnation of the wood with chemical substances toxic to fungi and bacteria is one of the most commonly used methods of preservation to make wood durable. One major drawback of this method is that it is toxic to many other organisms as well as to human beings. These preservatives do not prevent problems with dimensional instability.

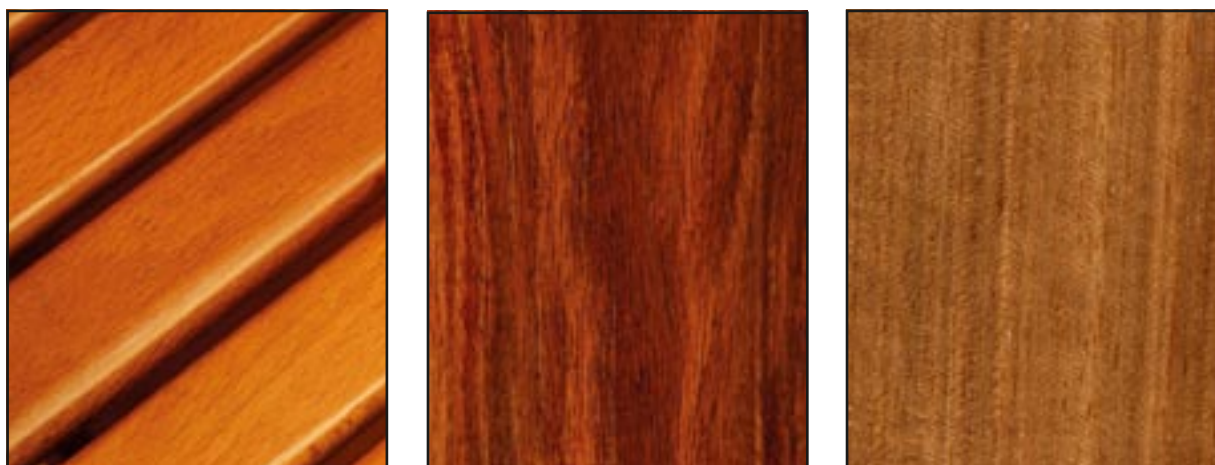
The use of heat treated wood in the European Union is facilitated by the prohibition placed by the European



Commission against the chemical treatment of wood. Similar bans have also been put into effect in the USA. Because heat treatment makes the wood more durable without the use of chemicals, many manufacturers turn to this new source of durable wood.

What is heat treatment?

For generations, it has been known that the weather-resistant qualities of wood could be markedly improved by charring. In ancient Africa, the natives would harden their wooden spears by placing a straight, sharpened wooden stick on glowing coals. After which, they would pound the burnt end with a rock, repeating this process many times until the end was sharp and hard.



Thousands of years later, we finally learnt that the process was pyrolysis of the hemicelluloses, producing furan resins, which combined with carbon and compression, result in this extremely hard composite.

The Vikings are another example of how pervasive the treated technology was. They burnt the outside of their ships to make them water-resistant, without knowing anything about hydrophobicity or the insulating properties of charred wood.

As we can see, thermal treatment of wood has been around for centuries. However, this technology was of no commercial interest due to the huge availability of cheap hardwoods. Today, this technology is extremely valuable and expensive to buy.

The process

When wood is exposed to high temperatures (200 degrees Celsius or more), its properties change significantly. Sugars inside the wood break up and turn into a form that rot fungi cannot use.

Heat treatment temperatures range from approximately 180 degrees Celsius to 250 degrees Celsius depending on the type of species and the physical-mechanical characteristics desired. The higher the temperature, the more durable the wood, and the darker the colour. However, at higher temperatures, the wood loses mass and strength.

Thus, the main objective is to reduce the hydrophilic behaviour of wood by the thermal modification of the chemical structure of some of its components in a controlled atmosphere.

In the thermal treatment process, water, steam, inert gases and high temperatures are used. The process conditions are corrosive along with the constituent compounds evaporating from the wood. The equipment used for the treatment has to be made of stainless steel and be able to withstand high treatment pressures.

Steam alone is not enough to heat up the equipment to very high temperatures. Normally, thermal oil heating is required. Relying on electrical heating alone would result in enormous energy costs.

Current technology

The idea of heat treating wood to make it more durable is not patentable as it has been practiced for thousands of years. It should be noted, however, that much research has been conducted and many papers have been published on this subject.

Most of the patents from different countries related to heat treatments differ in the use of the heating medium, the heating chamber, and the process parameters.

There are various wood thermal treatment systems available today. The strongest advocate and manufacturers of heat treatment technology are mostly from Europe.

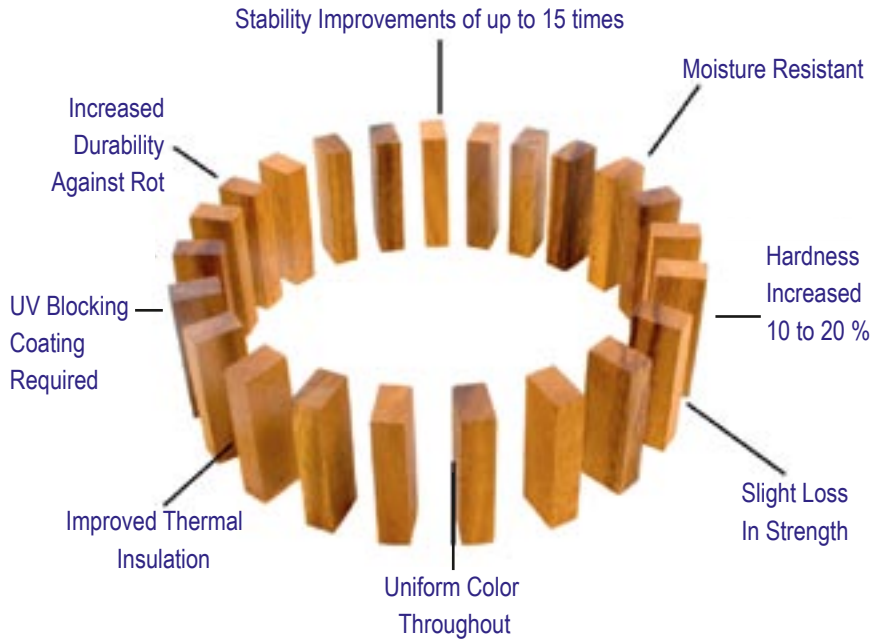
Aesthetics

Heat treatment gives wood a beautiful brown colour, like that of hardwood. Heat-treated wood is also an ecological alternative to tropical woods because of the beautiful and the pleasant colour it gives. The deep and warm colour makes heat treated timber very beautiful for outdoor construction, such as decking, cladding, shutters and outdoor furniture. After treatment, certain species can even look like Teak wood! There is a danger that in time to come, Asian tropical hardwood products will face great difficulty competing against heat treated timber.

Scenario in South East Asia

Many in the timber industry in South East Asia know the benefit of this technology. But the high initial investment cost (Euro 400 – Euro 1 million for a treatment chamber with ca-

Advantages of thermowood:



capacity ranging from 6 m³ to 60 m³) is not within the budgets of manufacturers who produce mostly outdoor furniture and flooring products. Their products are very competitive and the margins are low.

There is great interest in this new technology. Many different companies are trying to make heat treatment equipment, however due to the complexity of the process and the high temperatures involved, many have not perfected their equipment.

Asia needs to catch up with this technology in order to find new applications for their timber and develop new products for their customers. **PFA**



Tritherm currently has a heat treatment plant in Hanoi, Vietnam, operating under the name Vietnam Thermawood Technology Company Ltd. The plant is capable of producing 15 m³ per day. There are plans to increase the capacity to 30 m³ per day.

In their process, the parameters are designed such that the wood after treatment does not become too brittle and loses too much strength. The plant generates the heat from biomass combustion and minimum electrical energy is used. Tritherm is also researching into organic wood hardening and polymerisation chemicals in combination with heat treatment.