

Timber for Tomorrow:

The Benefits of Thermally-Modified Wood in Modern Construction

In this whitepaper, we provide a close look at how thermally-modified wood is made and the benefits it offers to sauna construction.

○ WHAT IS THERMALLY-MODIFIED WOOD?

In its natural state, wood is a biodegradable and dimensionally unstable material. Without modification, these properties create design limitations and can lead to issues during its service life when used for building purposes. Thermal modification is a non-toxic commercial treatment process that is used to improve wood's material properties, including its dimensional stability and biological resistance.

Open vs closed systems

Thermally-modified wood is modified by heating the material in high temperatures (>180 °C), changing its chemical structure. There are two prevailing treatment processes for thermally modifying wood – the **open** system and the **closed** system. The open system utilises steam from a boiler system that is situated outside the chamber unit. The steam protects the wood while it is heated and affects the chemical changes taking place in the wood. The closed system operates using high pressure (often above 100 psi) in a sealed, oxygen-free environment.

The open system allows the humidity, surface temperature and core temperature of the wood and relative humidity in the chamber to be controlled, resulting in higher quality thermal modification and structural changes in the wood. This treatment process is more universal, reliable and suitable for complex processes and is the most common industrial thermal modification method in Europe.

Thermal modification vs other wood treatments

Thermally-modified wood should not be confused with heat-treated wood or chemically-treated wood. Heat-treated wood is wood that is exposed to lower temperatures (approx. 55 °C) for the sole purpose of killing pests, such as in wooden pallets. Chemically-treated wood has been treated with preservative chemicals to prevent rot, decay and/or improve its resistance to fire.

By comparison, thermal modification preserves wood's natural beauty and versatility and enhances its durability, stability and resistance to moisture, rot and pests, making it suitable for a wide variety of applications. Unlike chemically-treated wood, which can release harmful toxins

if not handled correctly, **thermally-modified wood does not contain carcinogens, toxins or other volatile organic compounds**. This quality enables thermally-modified wood to be used in interior applications, where it is also valued for its visual appeal.

How is thermally-modified wood made?

The *Thermowood Handbook* describes the open system for manufacturing thermally-modified wood in three phases:

- **Phase 1.** In the initial phase, wood is heated in special kilns, first by using heat and steam to raise the temperature rapidly to approximately 100°C. The temperature is then steadily increased to 130°C – during this period, high-temperature drying takes place and reduces the moisture content of the wood to nearly zero.
- **Phase 2.** After high-temperature drying has occurred, the temperature in the kiln is raised to a target temperature between 185°C and 215°C. When the target temperature is reached, this temperature is held constant for 2-3 hours depending on end-use application.
- **Phase 3.** This is the cooling and moisture conditioning phase. The temperature is lowered using water spray systems. When the temperature reaches 80-90°C, re-moisturising takes place to increase the moisture content of the wood to a useable level (i.e. 4-7%).

During thermal modification treatment, steam is used as a protective vapour during drying and heat treatment, preventing the wood from burning. Heating causes the wood to become less hydrophilic, while positively influencing some of its chemical properties, resulting in enhanced rot resistance, durability and dimensional stability and reduced water absorbency. Different thermal modification levels can be applied depending on intended use.

When lowering or raising the temperature in the kiln, manufacturers use a special adjustment system to prevent surface and inside splitting and checking. Custom adjustment values are used for different wood species and dimensions.

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○ BENEFITS OF THERMALLY-MODIFIED WOOD



HIGH DURABILITY
Highest durability class



LIGHTER MATERIAL
Lower moisture content makes the material lighter



SUSTAINABLE
Chemical-free modification



STABLE
Most dimensionally stable in changing weather conditions



Thermal modification penetrates far below the wood's surface

Unlike chemical impregnation, thermal modification enhances the wood throughout, not just the outer surface. The result is boards that are stable and durable in every sense. At Thermory, we believe product quality is paramount, so we work hard on mastering our technology and innovate to stay ahead.

Durability

The thermal modification process removes or changes a remarkable part of natural food sources in wood and triggers several changes in its chemical and structural composition. Thermally-modified wood contains much less hemicellulose than untreated wood. Under high temperatures, some resin and sugars are cooked out, removing nutrients and changing the remainder into less valuable energy resources for living organisms such as pests and fungi. Significantly less hemicellulose content means much less appeal for natural decomposers of wood. Thermal modification also lowers the wood's moisture absorbency, so it does not require further chemical protection from rot.

Studies have shown that chemical and structural enhancements caused by thermal modification increases the service life of wood materials without the use of toxic chemicals. Due to its superior durability and stability, thermally-modified wood has replaced tropical hardwood in some markets.

Dimensional stability

Thermally-modified wood has much higher dimensional stability than untreated wood. Generally, dimensional movement in thermally-modified hardwoods is twice less than in the same untreated wood. This is due to the significant reduction in equilibrium moisture content and the strengthening of the wood's molecular structure from thermal modification.

This inherent stability renders thermally-modified wood exceptionally resistant to warping, swelling, or shrinking, even in the demanding environment of saunas. The wood's reduced absorptive nature ensures that it retains its shape for an extended period, contributing to a prolonged service life and sustained optimal performance. Moreover, its exceptional resistance to heat and moisture positions thermally-modified wood as the premier choice for sauna construction, surpassing traditional treated wood in durability and weather resistance.

Eco-friendly and sustainable

Increasing awareness of the impact of climate change has driven greater demand for sustainable development worldwide. Wood is gaining importance as a high performing building material that is renewable and unrivalled in terms of costs and environmental impact. However, some wood species have poor resistance to biological degradation and low shape stability, limiting their suitability for some building applications.

Thermally-modified wood is the superior wood product for sustainable building for the following reasons:

- Thermal modification improves the characteristics of wood such that it can be used for more building applications and with a longer service life.
- Thermally-modified wood is lightweight, which contributes to less energy-intensive construction, it is also easier to transport and work with, which saves projects time and reduces transport, installation and labour costs.
- If it is sourced from sustainably-managed forests, thermally-modified wood has minimal impact on natural resources.
- Unlike chemical treatments, thermal modification is free of toxic substances that could otherwise be harmful to human health and the environment.

Low maintenance

Traditional treated wood has significant maintenance requirements, including ongoing staining, waterproofing and sealing. These treatments ensure the product maintains its look, performance and structural integrity over its service life. Thermally-modified wood due to its enhanced properties, especially its resistance to water and decay, has comparatively reduced maintenance requirements and costs overall.

In the context of sauna maintenance, the exceptional stability of thermally-modified wood is a game-changer. Its resistance to warping, swelling, or shrinking means that there's no need for constant adjustments to the frame bands, particularly evident in barrel saunas. This innate quality not only simplifies the maintenance process but also sets thermowood saunas apart, offering a distinct advantage over those built with untreated wood.

Thermally-modified wood retains its shape for longer, increasing its service life and maintaining optimum performance for a longer period of time

◦ THERMORY

VMS Saunas exclusively employs Thermory's thermowood in its sauna production. For more than 20 years, Thermory has been a global leader in thermal modification – a sustainable technology for high quality lasting wood solutions. The company has worked closely with architects, designers, real estate developers and specialised distributors to deliver thousands of beautiful projects across 50+ countries on all continents.

Using only heat and steam, Thermory creates extremely durable and climate-resistant decking, cladding, flooring, wall paneling and sauna products that are unrivalled in both performance and sustainability versus the usual alternatives such as plastic composites, chemically-treated woods and tropical hardwoods.



Thermory's products are thoroughly tested



HIGH DURABILITY



STABILITY



TERMITE RESISTANCE

◦ THERMORY thermally modified wood products are tested

We know our thermally modified wood products are top of the line. If the correct installation techniques are used, they will last for decades. Our products are consistently proven through third-party test results.

→ [Read more about certificates and tests](#)



Ignite by Thermory. A high performance alternative to traditional Japanese charred timber treatment, Ignite offers the shockingly realistic look of charred wood, while delivering durability all the way to the core and no messy residue.

Ignite's bold aesthetics are combined with superior stability and durability, and a 25+ year rot resistance rating.



The look of charred wood, without the torch

The signature dragon-scale pattern of Thermory Ignite cladding is created by embossing and tinting thermally modified spruce wood. Unlike modern yakisugi, which is often created by hand with a torch, Ignite is produced using a deceptively flame-free process.

A longer-lasting appeal

Over time, the charred surface of yakisugi cladding becomes tarnished and carbonized particles fall away. In addition, this type of cladding can't be maintained – it is meant to change over time. Ignite's pattern is permanent, and the surface color also lasts longer thanks to Thermory's intense thermal modification process.

