

ThermoWood®



FINNISH
ThermoWood
ASSOCIATION

The manufacturing process of ThermoWood is based on the use of high temperature and steam. No chemicals are used in the treatment. The process improves dimensional stability and biological durability of wood. Another improvement is in the insulation properties of the final material, the process leads to a reduction in thermal conductivity. Due to the high treatment temperatures the resin is removed from the wood.

The ThermoWood treatment process is patented and the trademark is owned by the Finnish ThermoWood Association. The process can be divided into three phases:

1. Temperature increase and kiln drying

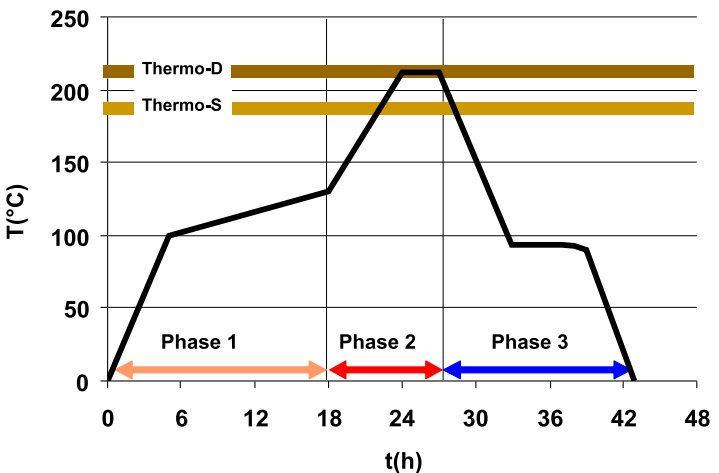
The air temperature in the kiln is raised at a rapid speed using heat and steam to a level of around 100 °C, the wood temperature follows at a similar level. Thereafter the temperature is increased steadily to 130 °C and drying takes place. Either green (un kilned) or ready kiln dried raw material can be used. Steam is used as a vapour membrane to prevent cracking of the wood. The steam also facilitates chemical changes taking place in the wood. At the end of this phase the moisture content is reduced to almost zero.

2. Intensive heat treatment

During the intensive heat treatment phase the air and wood temperature is increased to a level of between 185 – 225 °C. The peak temperature depends on the desired end use of the material. When the target level is reached the temperature remains constant for 2 – 3 hours. Steam is used to prevent the wood from burning and cracking and it also continues to influence the chemical changes taking place in the wood.

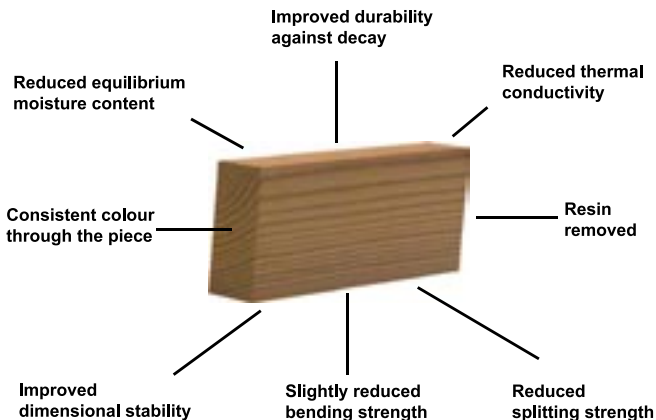
3. Cooling and moisture conditioning

The temperature is reduced using water spray systems. Conditioning and re-moisturising takes place to bring the wood moisture content to a workable level over 4 percent.



KEY CHARACTERISTICS OF ThermoWood®

ThermoWood® - properties



1. Density

The density is measured by measuring the weight and the dimensions of the sample. The unit of density is kg/m^3 . The ThermoWood process reduces the density by about 10 % on average.

2. Strength

Generally the strength of wood has direct correlation with density. The ThermoWood process slightly lowers the density and therefore some effects on the strength values occur, but weight-strength-value can be practically unchanged.

- *Bending strength and modulus of elasticity*

Material treated at temperatures below 200 °C does not experience a significant loss in bending strength. A clear reduction in horizontal bending strength can be found in material treated at temperatures above 200 °C. The ThermoWood process has been found to maintain or even slightly improve the modulus of elasticity. At this stage it is recommended that ThermoWood is NOT used for horizontal load bearing structural usage.

- *Compression strength*

The Compression strength is mainly dependent on the actual density of wood. According to tests it has been found that the ThermoWood process has no significant effect on the compression strength values.

- *Splitting strength*

The ThermoWood process can cause some reduction in the splitting strength depending on treatment temperature, the reduction increases as the temperature goes over 200 °C.

- *Screw holding strength*

The screw holding strength has a strong correlation with density. The main effect on screw holding strength comes from the general variance in wood density rather than from the ThermoWood process. It was found that material with lower density has better results when narrower pre-drilled holes are used.

3. Surface Hardness

The ThermoWood process has limited effects on the Brinell hardness properties, variance is more related to the density and the wood species being used.

4. Equilibrium moisture content

The ThermoWood process leads to a reduction in equilibrium moisture content. When treated at the highest temperatures the equilibrium moisture content can be 40-50 percent lower compared to untreated wood.

5. Stability

Because of lower equilibrium moisture content and the changes in the chemical composition of the wood the tangential and radial swelling decreases significantly compared with the original material. In some cases the reduction in dimensional movement can be as much as 40-50%.

6. Permeability

The ThermoWood process reduces the water uptake of wood, the levels may differ depending on the original wood species.

7. Thermal properties

The tests have shown that the thermal conductivity of ThermoWood is 20 - 25 percent lower compared to untreated wood, thus giving improved insulation performance.

8. Biological durability

Standard tests (EN 113, ENV 807) made in laboratory conditions have proven a significant improvement in biological durability. Improvements in biological durability are a result of the removal of natural food sources in the wood and also changes in the chemical and structural composition. Levels of resistance to fungal decay increase as higher temperatures are used. ThermoWood is recommended to be used in hazard classes 1 to 3 in accordance with EN-335-1 without the need for any further chemical protection. The treatment is throughout the wood piece and is not subject to leaching problems.

9. Weather resistance

As with most materials, ThermoWood is unable to resist the effects of ultra violet radiation. As a result, over a fairly short period of time when exposed to direct sunlight, the colour changes from the original brown appearance to a grey weathered colour. In addition the ultra violet radiation can cause small surface shakes to occur. Natural effects of rain and sun will cause some early wood to be removed from the surface, especially on un-coated boards, this occurs with all wood material over time.

It is highly recommended to apply a pigment based surface protection to prevent colour changes and other natural effects of the weather, more information can be found from the Finnish ThermoWood association surface coating handbook.

RAW MATERIAL OF ThermoWood®

The ThermoWood treatment process is suitable for most wood species but the process must be optimised individually by species. Demands of raw material quality are very tight. Minimum quality demands of sawn timber used as ThermoWood raw material are defined in the Finnish ThermoWood Association quality handbook. Quality demands are defined for sawn timber produced from pine, spruce, birch, aspen and alder.

TREATMENT CLASSES OF ThermoWood®

Two standard treatment classes for softwoods and for hardwoods have been introduced. These classes have been developed to take into account the key characteristics of ThermoWood, standard temperatures have been selected to ensure best overall technical performance of the final product. The standard treatment classes are named Thermo-S (190°C +/-3°C) and Thermo-D (212°C +/-3°C) for softwoods, and hardwoods Thermo-S (185°C +/-3°C) and Thermo-D (200°C +/-3°C).

End use recommendations:

Softwood (pine, spruce)	
Thermo-S	Thermo-D
<ul style="list-style-type: none"> - building components - wall and ceiling panels in dry conditions - furniture - garden furniture - door and window components - sauna products - flooring - fascia boards - cladding - shutters 	<ul style="list-style-type: none"> - cladding - fascia boards - exterior joinery - shutters - sound barriers - sauna and bathroom furnishing - decking - garden furniture - other exterior structures

Hardwood (birch, aspen)	
Thermo-S	Thermo-D
<ul style="list-style-type: none"> - wall and ceiling panels - furniture - garden furniture - flooring - sauna products 	<p>End uses of hardwood Thermo-D products are same as Thermo-S products. The colour is darker because of higher treatment temperature</p>

In addition to standard classes it is possible to produce ThermoWood in higher or lower temperatures for special purposes. Specific treatment levels can be agreed between the ThermoWood producers and industrial customers so as to optimise the needed characteristics in relation to the end use application.









*Birch,
unmodified*



*Birch,
Thermo-S*



*Birch
Thermo-D*



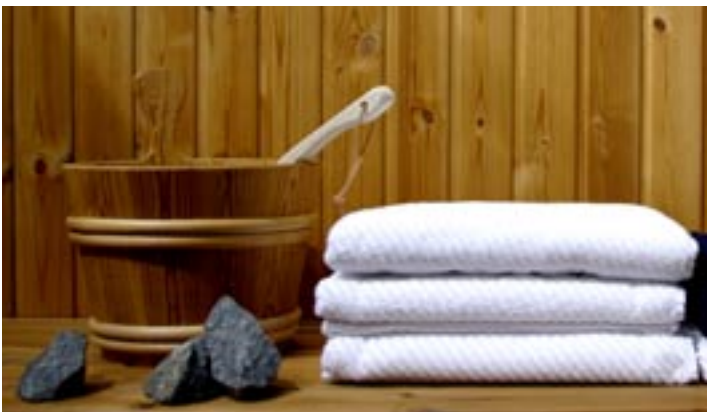
*Pine,
unmodified*



*Pine,
Thermo-S*



*Pine,
Thermo-D*



1. Sawing

Sawing of ThermoWood does not significantly differ from sawing of untreated wood. Due to the stabilisation of the wood after ThermoWood process the effect of further distortion after sawing is reduced.

As the resinous substances have been removed during the ThermoWood process, the machines work well and are cleaner after processing. Good dust extraction systems will be needed when sawing in factories.

2. Planing

Standard planing equipment can be used when further processing ThermoWood. Some care should be taken in the set up of the infeed rollers to reduce the risk of cracking the material. Excellent planed surface quality can be achieved. Best results are achieved when hard metal blade cutters are used. Similar processing parameters to planing hardwoods should be followed. Good dust extraction systems will be needed. More information is available from the Finnish ThermoWood Association planing handbook.

3. Milling

In order to get a good surface quality, blades must be sharp, otherwise tearing may occur. Greater tearing is observed when the wood is milled across the grain. The highest risk of tearing occurs at the start and end of the milling. The best results are obtained when there is sufficient solid wood material behind the blade. Processing must be pre-planned carefully.

4. Sanding

There is very often no need for sanding, because after planing or milling ThermoWood has an excellent surface quality. Sanding is easy and the sand paper does not become clogged up by resin. When machine sanding, good extraction systems are needed.

5. Surface treatment

To prevent colour changes and other natural effects of weathering it is recommended that surface treatment is used.

Oil-based substances work well and in a similar way as with untreated wood. When working with water-solvent substances it has to be taken into account that ThermoWood has a lower water absorption rate than normal wood, this can have an effect on drying time and penetration. Results are also dependent on the paint application and drying process. The paint manufacturer's instructions should be followed. More information can be found from the Finnish ThermoWood Association surface coating handbook.

6. Gluing

ThermoWood has a slower water absorption rate, high moisture content glues, such as PVCa can take longer to dry and longer pressing times may be required. When working with PVCa glue the moisture content of the glue should be as low as possible. Two pack PVCa glues which include a chemical hardener give good results and speed up the drying time significantly.

PU (polyurethane) glues work well with ThermoWood. When using PU-glues, it has to be taken into account that the hardening reaction of PU needs water. The water can be absorbed either from the wood or surrounding air. If both wood and air are very dry, gluing may fail.

When gluing ThermoWood, the glue manufacturer's specific instructions must always be referred to.

7. Mechanical joints

- *Screwing*

The ThermoWood process can reduce splitting strength of wood. The use of self-tapping screws or pre-drilling of holes must be made to avoid cracking of the material. It is recommended to use low threaded screws. It is very important to use stainless steel screws with counter-sunk heads for external usage or in other humid environments.

- *Nailing*

Best results are gained when using a compressed air nail gun with adjustable nailing depth on the gun. Using a normal hammer increases risk of splitting due to accidental hammer contact with the wood.

It is very important to use stainless steel or other rust free nails when fixing ThermoWood outside or in humid conditions. If using a compressed air nail gun, galvanised nails can be used as no metal on metal contact occurs to break the galvanised seal. Galvanised nails are also working, if ThermoWood will be treated with covering paint after nailing. It is also recommended to use small oval head nails as this also helps to reduce the risk of splitting.

Additional points when working with ThermoWood:

- Sharp tools should be used to achieve best results
- The dust has smaller particle size than normal wood. Special attention has to be paid to the dust extraction system and when working in confined spaces dust masks should be used.

ENVIRONMENTAL ASPECTS

ThermoWood is a natural wood product without any chemicals additives. ThermoWood waste can be handled as with any other untreated wood waste. The material is bio-degradable and can be disposed of at the end of its service life by either burning or placing into the normal waste system.

In most cases energy needed for the ThermoWood process is produced by burning bark and wood waste. Additional energy is provided with solutions such as natural gas. Energy is needed mainly for drying, which accounts for 80 percent of the heat energy used. The production of ThermoWood consumes about the same amount of electricity as is used in normal kiln drying of sawn timber.

FINNISH ThermoWood ASSOCIATION

Finnish ThermoWood Association was established in December 2000. The aim of the association is to enhance the use of ThermoWood produced by its members. Other important duties of the organisation are quality control of production, product classification and R&D activities.

Further information

The following documents
are available on the
Finnish ThermoWood Association website

www.thermowood.fi

ThermoWood® Handbook

ThermoWood®
Surface coating handbook

ThermoWood® Planing handbook

ThermoWood®

*ThermoWood® is a registered trademark
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