

## MAJOR FEATURES OF THERMO-TREATED WOOD

Parameter	Effect	Comments
<b>Equilibrium moisture</b>	Reduced 50% compared untreated wood. The difference is higher, the relative humidity is higher.	This difference remained after years of exposure. After thermo treatment the wood is dry - moisture content is 4-6%.
<b>Dimensional stability</b>	The swelling and shrinkage (both tangential and radial) reduces 3-5 times for softwoods and up to 15 times for hardwoods. This parameter is strongly depends on the relative humidity (at 100% reduces 2 times for softwoods and 3-5 times for hardwoods)	This because of the decrease in absorptive qualities, lower equilibrium moisture content and also due to lignin depolymerization the length of chains of cellulose decreases and this leads to the deformations decrease.
<b>Color</b>	Attractive golden brown appearance and even color at all depth.	The color is affected by the treatment temperature and time. It is possible to receive several gradations of color based on the process.
<b>Appearance</b>	Attractive golden brown appearance and even color at all depth. Color becomes more sated and homogeneous on all section; the structure of wood effectively comes to light.	The color is affected by the treatment temperature and time. It is possible to receive several gradations of color based on the process. The effect of valuable breeds of wood is reached.
<b>Density</b>	Lower density at 5-10%.	Due to the emissions during the thermo-treatment process and lower equilibrium moisture content. This feature might improve the cost-efficiency of shipping of the treated material.
<b>Cell structure</b>	Changes as if after ageing for 120-250 years.	The color is affected by the treatment temperature and time. It is possible to receive several gradations of color based on the process. The effect of valuable breeds of wood is reached while the absorption of moisture is decreased.
<b>Resin</b>	Is almost fully removed.	
<b>Brinell hardness</b>	Increases as the treatment temperature increases. However, the relative change is very small, as the density decreases.	Certain kinds of timber change their place on the hardness scale, as some of them become harder, while others softer as a result of the treatment temperature and specie.
<b>Permeability</b>	The water uptake reduced up to 5 times depending on treatment temperature.	The surface of the thermo-treated wood is not porous but solid, also the chemical composition of the wood changes. Reduced water absorption has to be taken into account when working with water solvent glue or paint.
<b>Thermal conductivity</b>	Decreased by 10-30%.	Thanks to the lower water content and structural changes.
<b>Fire resistance</b>	The same as non-treated wood. Thermo-treated wood is in fire class D.	The time of ignition a little decreased, but better than the normally dried softwoods in terms of heat and smoke release.
<b>Resistance to insect attack and termites</b>	Significantly increased resistance to the hardwood and softwood insects, but only a little increased resistance to the termites (it is expected that termites will choose normal wood over thermo-treated).	Tests have been carried out in Europe to evaluate the resistance to attack from the three most common wood boring insects found in Europe. House Longhorn beetles ( <i>Hylotrupes bajulus</i> ) are found in the sapwood of softwood, the common furniture beetle ( <i>Anobium punctatum</i> ) preferentially attacks hardwoods and the Powderpost beetle ( <i>Lyctus brunneus</i> ) is found in some hardwood species. The results of the tests found that thermo treated wood was resistant to all three of the above insect species. Southern European Subterranean termites ( <i>Reticulitermes</i> spp) found in Europe only attack buildings from the earth below, avoid-ing direct sunlight where possible. Termites will attack both wood and concrete based materials in their quest for a strong food base. Various measures have been developed to control the prob-lem including polythene membranes being installed in the founda-tions and various bituminous paint products are available to seal possible routes up the building.
<b>Rot resistance</b>	Improved.	However it is not suitable for conditions where it would be saturated with water or in prolonged contact with damp ground.

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<b>Biological durability</b>	European tests on biological durability of thermo treated wood in EN 113, ENV 807 standards showed significantly improved level of resistance against fungi attack (15-25 times) depending on treatment temperature.	Thermo-treated wood does not require any chemical protection. Due to high heat of processing in wood decay hemi-cellulose and poly-sugars, that on a background of low equilibrium humidity eliminates conditions for occurrence and duplication of a fungus and microorganisms. Biodamaging agents (insects and those larvae, bacteria, fungi and their disputes) are destroyed. According to tests the wood, treated at 410F should obtain durability class 2; upper 430F with 3 hours of treatment is class 1 (30 years service life outdoor). The best results can be achieved when the material is used in above ground applications with good ventilation and no water-trapping.
<b>Weather resistance</b>	Being a natural material exposed to weather effects (ultraviolet radiation and rain) it will start to grey without coating in approximately one summer. When left without surface protection small surface shakes can also appear.	As the thermo-treated wood has even brown color in depth, the original color can be easily restored by simply sanding the surface. Or recommended to apply a pigment based surface protection to prevent color changes and surface shakes. Strongly recommended apply of high-build stains and oils protected (the best are priming oil and solvent-based alkyd or water-based acrylic topcoat), otherwise the low-build coatings wore away and annual rings started to loosen just as in the panels without coating. The panels coated with the low-build stains showed a strong tendency to crack. Due to bacteria in the air or dirt carried in the rain, fungi can grow on the untreated surface. However, this is on the surface only and can be removed by wiping or scraping.
<b>Ground contact</b>	Not recommended to be used in deep ground applications where structural performance is required.	It is assumed that the indicated loss of strength is due to moisture and to any micro-organism. However practical experience has found that usage of highest temperature treated material in ground contact where structural performance is not critical and periodic drying of the surfaces is allowed does not cause any significant deterioration to the material. This is especially apparent when the ground has good drainage and is made up of sand or shingle.
<b>Emissions</b>	Total volatile organic compounds are significantly lower (250-800 mg/m <sup>2</sup> h) than with normal kiln dried material (1500 mg/m <sup>2</sup> h).	The most of thermo-treated wood emission is acetic acid (110 mg/m <sup>2</sup> h). The smoke-like smell that comes out of thermo-treated wood (most likely comes from furfural) disappears almost totally with time or after coating.
<b>Environmental purity</b>	Absolutely.	The thermo-treatment is made without insertion of any chemicals. With guarantees at least the same class of durability as the chemically protected wood, thermo-treated wood holds no danger for the environment.
<b>Utilization</b>	Needs no additional conservation	Can be easily utilized at the end of its life cycle unlike the chemically treated lumber.
<b>General strength</b>	Reduced proportionally the density reduction.	Generally the strength of wood has strong correlation with density. Thermo treated wood has slightly lower density and correlated lower strength values, but weight-strength-value can be practically unchanged.
<b>Bending strength</b>	Lower (1-30%) especially for lumber with knots and highly depends on treatment temperature.	It is recommended that deep thermo treated wood is NOT used for load bearing structural usage. On the other hand, it was found that the light treatment renders positive influence on elasticity of molecules of wood.
<b>Dynamic bending strength</b>	Lower (1-25%) especially for lumber with knots and highly depends on treatment temperature.	
<b>Compression strength</b>	The thermo-treatment process has no negative effect on the compression strength values.	This property depends mainly on density of wood. Moreover, in some cases results better, than for dried up wood.
<b>Shear strength</b>	Radial values reduced 1-25 percent and tangential values 1-40 percent.	Highly depends on treatment temperature.
<b>Splitting strength</b>	Reduces 20 -40 percent depending on treatment temperature.	Hardwoods show better results than softwoods.
<b>Screw holding strength</b>	Bigger effect on screw holding strength comes from the general variance in wood density than thermo-treatment process.	It was found that the results were better when narrower pre-drill holes were used for material with lower density.