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HEAT TREATED WOOD

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ABSTRACT
Heat treated wood is a product which is obtained by intensive treatment of a wood at high temperatures (160-260 ºC). Thus, treated wood permanently changes its properties. Changes occur mainly in hemicelluloses degradation. As a consequence, the reduction of equilibrium moisture content, saturation point, shrinkage and swelling is about 50%, which leads to have more stable wood in use. Thermally treated wood shows increase in natural durability and insulating properties and reduction in water permeability. The growth of wood hardness is about 5%. Negative effects of heat treatment may include reduction of some mechanical properties (i.e. bending and tightening). The reduction of the mechanical properties is about 10-30%. Heat-treated wood is an ecologically clean material in the production and use. The most common use is for external cohesion less structure, cladding, windows, doors, flooring, saunas, swimming pools and the like.
Key words: heat treated wood, properties, technology, application.

1. INTRODUCTION

Natural durability of most tree species is limited. In an attempt to solve this problem by using a thermal treatment at relatively low temperatures, up to about 150 º C. In recent years in Europe to develop environmentally acceptable methods of heat treatment of wood at higher temperatures up to 260 º C. Provided the wood with increased dimensional stability and with the increased durability of the natural. Have been developed industrially applicable technology, heat treatment of wood. The process is carried with inert atmosphere (water vapor, carbon dioxide, nitrogen), or wood the overheating submerged in an industrial oil. Heat treated wood (HTW) is commonly used in outdoor construction for facades and fences, outdoor flooring and windows and door.

2. PROPERTIES

Heat treated wood, the product is obtained by intensive treatment of wood at an unusually high temperatures. Such overheating of wood permanently changes the more it chemical and physical properties [1].

By changing the chemistry of cell wall decreases its affinity for water and improves the dimensional stability of wood, increases the resistance of wood to biological degradation and contributes to the deep, uniform color change to dark. Should bear in mind the lack of materials: mechanical properties of such wood were substantially reduced, wood is prone to surface cracks and can not be applied in contact with the ground [2].

When heating wood without oxygen is first degraded hemicellulose, cellulose, and then at the end of lignin. Therefore, heat treated wood has a higher percentage share of lignin than normal wood.

Organic acids and phenolic units of lignin, which occur during the warm-up together in formaldehyde, which networked and thus reduces the bound water in wood [3].

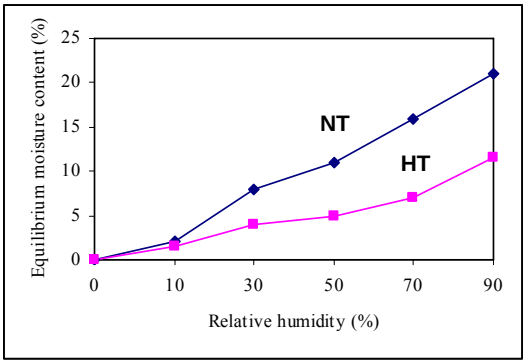

Figure 1. Equilibrium moisture content untreated (NT) and heat treated (HT) of spruce wood

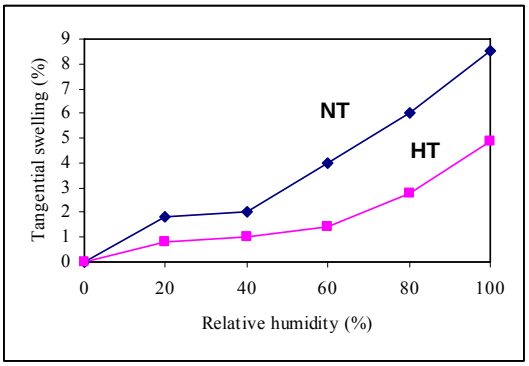

Figure 2. Tangential swelling untreated (NT) and heat treated (HT) of spruce wood

Equilibrium moisture content of wood is reduced by 50%, as we see in the figure 1 for untreated and treated spruce. The results of ten years of exposure to thermally modified wood outside weather influences showed very small dimensional changes in the modified samples in comparison with the unmodified [4]. The equilibrium content of water and after three years of exposure was 40-60% lower than the unmodified samples, regardless of the surface treatment system. This means that the same relative humidity wood hygroscopic received almost twice as less water, which causes the reduction of dimensional shrinkage. Heat treated the beech so shrinkage up to 13% less than normal, the conifers to reduce around 40%[5]. Heat treatment slows the receiving water and the cell walls absorb less water because it reduces the number of free hydroxy group. Speed absorption of moisture is reduced, and swelling (fig. 2).

Water absorption and water vapour permeability is decreases as they are shown for treated investigation maple [6]. The water permeability decreases. Examined the permeability to water by dipping the treated and untreated spruce wood in the water during 72 hours with samples sealed foreheads. Untreated wood is subsequently contained 22% water, while treated at a temperature of 195 ° C in 12% water, and at a temperature of 210 ° C, 10% water. Degradation of polysaccharides will cause weight loss or decrease in density, which is greater the higher temperature treatment.

Of course, will cause degradation of the polysaccharide and significantly reduced all the mechanical properties of wood, except for hardness, resulting in a tendency brittle and numerous small surface cracks in heat treated wood in use. Flexural and tensile strength he reduced by 10% to 30% and wood becomes very brittle, which limits its use for no load-bearing building elements.

The Radial hardness increases, as can be seen in untreated and heat treated oak (Fig. 3) [1].Strength of impact heat treated wood is lower than normal, artificially dried, wood. Examination of spruce wood, treated at a temperature of 220 ° C for 3 hours, there was a decrease in impact strength about 25%. Shear strength was tested in the radial and tangenial plane. It was found that the sharp temperature treatment (temperature 230 ° C for 4 hours) reduced strength in the radial plane of 25%, and tangential level for 40%. However, previous treatment of wood at a lower temperature of 190 ° C had very little effect on the pine, while the smrčevine caused a decrease of 20% in the radial and tangential plane [12].

The reduction of bound water is the main factor blocked by biological activity, and probably many, mainly acidic and mildly toxic, products of degradation inhibition effect on the fungus causes rot [7]. Studies have shown that the resistance of treated wood against wood decaying fungi increases with increasing degree of modification [8]. Increasing the natural durability of a laboratory test EN113 proved to be very good depending on the temperature and length of treatment.To produce heat treated wood, which is very resistant to attack decaying fungi require a minimum temperature of 220 ° C and

exposure time of 3 hours. Increasing the biological durability is caused by chemical degradation of wood components and formation of new compounds. Essential changes that occur in this time chemistry wood is still not fully understood.

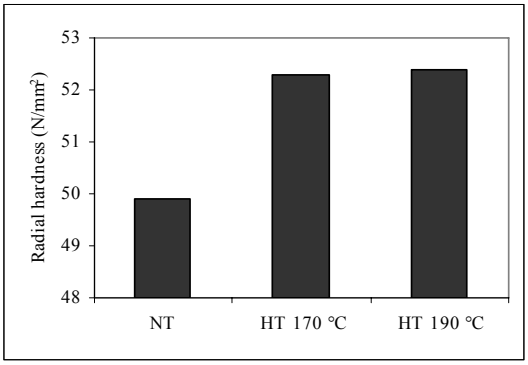

Figure 3. Radial hardness untreated (NT) and heat treated (HT) oak wood

Heat treated wood also improve the thermal insulation properties and in coniferous and removes resins from the wood. Thermal insulation heat treated wood is higher by 10-30% compared to the usual timber.

At the same dark color. Extending the time of modification changes the color of wood, especially the brightness of the color [9]. At first application of the method of thermal modification of color change was considered defects, but it is now one of the reasons the application since it is possible to achieve the color of other types of wood throughout the cross section element [10].

Weak aroma of the treated wood is present. Smell like the smell of smoke is probably coming from furfural immediately after treatment. However, it is not so intense and over time it loses, after surface treatment scent completely disappears.

3. TECHNOLOGY

Main reason for this kind of heat treatment of wood has not previously been commercialized solution flammability of wood in his presentation by high temperatures. The presence of oxygen during the heating process of wood can result in significant damage to cellulose, and consequently a decrease of mechanical properties of wood [9]. Because the process is usually carried with inert atmosphere (water vapor, carbon dioxide, nitrogen), or overheating wood submerged in an industrial vegetable oil [11]. Duration of the process and temperature is defined as the degree of modification of wood. What is the duration longer, to have dimensional stability and durability of modified wood higher, the density and mechanical properties are reduced.

Today in Europe we have some technological processes in use: Plato-process in the Netherlands, NOW and BCI-MBS process in France, OHT-Process in Germany and Thermo Wood process in Finland. All these European processes of heat treatment of wood generally used cut timber to be heat-treated at temperatures between 160 and 260 ° C. The main differences between the individual processes can be found in the wood processing regimes (gradual process, oxygen or nitrogen as protective gas, steaming, wet and dry treatments, the use of oil management regime, etc.). Total duration of the process (stage drying, heat treatment of active phase and the phase of cooling and conditioning), depending on the type of process, humidity, type and dimension of the input raw material, is between 1.5 and 3 days. [12].

In the technologies of heat treated wood, the brittleness also contribute to the onerous technological characteristics: processing develops more refined, irritating dust, surfaces treated wood is a needle and rough, it is easy to cleaved and separated into a sharp chip.

4. APPLICATION

The allegations of heat treated wood as the material has already been present for several years on the European market, clearly indicate that it possesses a number of advantages and has a broad application field. Thermally treated wood gets a look of old wood and is used for imitation of the rustic building, and the superheated leaved give the impression of exotic wood. Less valuable materials, such as lack of core beech and ash, this process can be transformed into an aesthetically and technically valuable products (eg exclusive parquet), and overheated birch and poplar in Scandinavia used for saunas and furniture. However, the heat treated wood is commonly used in outdoor construction for facades and fences, fully supported structure, floors and windows and doors.

High resistance to moisture and rot seems heat treated wood excellent material for outside furniture and wooden structures in the gardens and terraces. However, it is not entirely appropriate for the conditions in which may lead to supply water or prolonged contact with moist soil.

The exceptional thermal insulation and the absence of resin properties heat treated wood are almost ideal for warm and moist interiors such as saunas or laundry. When applying for floor coverings and furniture in particular come to the fore exceptional dimensional stability heat treated wood and its beautiful colors. Namely, intensive heat treatment leads to the whole scope of attractive brown shades and tones.

5. CONCLUSION

The processes of thermal modification of wood is still being investigated. Although heat treated wood shows the advantage in terms of aesthetic properties (uniform and effective change in color) and some technical guidelines (much reduced swelling and shrinkage and improved resistance to the fungus), should be aware of its shortcomings when compared with normal wood. The mechanical properties are substantially reduced, so that the material generally used for fully supported the structure. Further investigations on the reaction of each type of wood to overheating because it was shown that different types of wood react very differently, and explore the relationship of physical determinants of the procedure of processing and consequent changes in the wood.

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