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REINCREASING VALUE OF SOLID WOOD

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Abstract

Popularity of solid wood which has many positive features, decreased due to increasing popularity of both wood-based products and non-wood products such as metal, plastic, fiber-particle board etc. with technological improvement. However interest to solid wood material increased with ecological awareness and featured natural solid wood product designs in recent years. Naturally share of furniture industry cannot be ruled out to effect of the increment.

In this study, increasing value of solid wood will be tried to explain with natural solid wood products which were previously evaluated defective or waste and effect of furniture industry appealing more to end-user. For example increasing natural-life awareness caused to orient end-users towards to natural products like solid wood. In recent years the developed technologies such as high frequency-vacuum drying and thermo treatment technologies contributed positively by reason of adding value to solid wood with increasing features without using addictives, as a result of that these techniques expanded usage area of solid wood.

Keywords: Natural Solid Wood Product, Furniture Industry, Thermo Treatment, High Frequency-Vacuum Drying

MASİF AHŞABIN DEĞERİNİN YENİDEN ARTMASI

Özet

Teknolojinin gelişimiyle birlikte metal, plastik, lif-yonga levha gibi ahşap levha esaslı ve ahşap olmayan ürünlerin çeşitliliğinin artmasıyla, sayısız olumlu özelliği bulunan masif ahşabın popülerliği azalmıştır. Ancak bu malzemeye olan ilgi, ekolojik farkındalık ile son yıllarda farklı tasarımlarla üretilmeye başlanan doğal masif ahşap ürünlerle artmaya başlamıştır. Doğal olarak mobilya endüstrisinin bu artışa katkısı yadsınamaz.

Bu çalışma kapsamında masif ahşabın artan değeri, önceleri kusurlu veya atık olarak nitelendirilen doğal masif ahşap ürünlerin daha çok son kullanıcıya hitap eden mobilya endüstrisinin etkisi ile açıklanmaya çalışılacaktır. Örneğin artan ekolojik yaşam bilinci, son kullanıcının masif ahşap gibi doğal malzemelere yönelmesine sebep olmuştur. Son yıllarda geliştirilen ve masif ahşabın birçok özelliğini katkı maddesi kullanılmadan arttıran yüksek frekans-vakum kombinasyonlu kurutma ve ısıl işlem gibi koruma teknikleri de masif ahşabın kullanım alanlarını arttırmaya yönelik olumlu katkı yapmıştır.

Anahtar Kelimeler: Doğal Masif Ahşap, Mobilya Endüstrisi, Termo İşlem, Yüksek Frekans-Vakum Kurutma.

1 Introduction

In Turkey, trend to natural solid wood products continues increasingly in the last period. Habits of using environment-friendly natural products and targets aiming to increase life quality are effective in this trend. At this point, sustainability notion couldn't have been distinguished oneself on produced solid wood products by the reason of raw material value and endproduct quality. It can be seen easily from entrepreneur failures with not to comply technical trues that are essential of sustainability value-added products.

When examined the range of natural wood products that; natural wood table and coffee tables (a), luxury yacht equipments (b), furnitures from wood panels (c), private & unique furnitures (d), one-piece and big-sized materials as wooden beam and column applications in historical buildings (e), log cabin applications (f), toys and boutique products from solid wood (g), laminated wooden windows (h), restoration applications in historical buildings (i), laminated wooden beams and columns (j), big-sized solid wood products at docks (k) and gunstock from scirrhous timbers (l) are only few of them (Figure 1).

2 Sustainability Criteria for Value-Added Solid Wood Products

It should be understood from this sustainability term for solid wood that these products must preserve stability, form, mechanical strength and natural resistance (to biological attacks) at usage areas for decades, not few years. To provide them, some quality criteria can be said that essentials come to forefront according to usage area. These are choosing right wood specie, proper design, surface protection precautions, homogenous drying until required moisture levels, thermo treatment applications and impregnation applications for outdoor products preserving to biological attacks etc.

At this range, only way is drying for realizing other quality criteria fully and correctly. Even if other criteria were provided and drying didn't perform correctly, the product can't be maintain its form for a long time. Because solid wood can't be used without drying until 19%. For example, moisture content falls to nearly 5-6% levels for interior wares that stability and processing quality are important factors for these products, while this level reaches until 19% for impregnated products at outdoor applications.

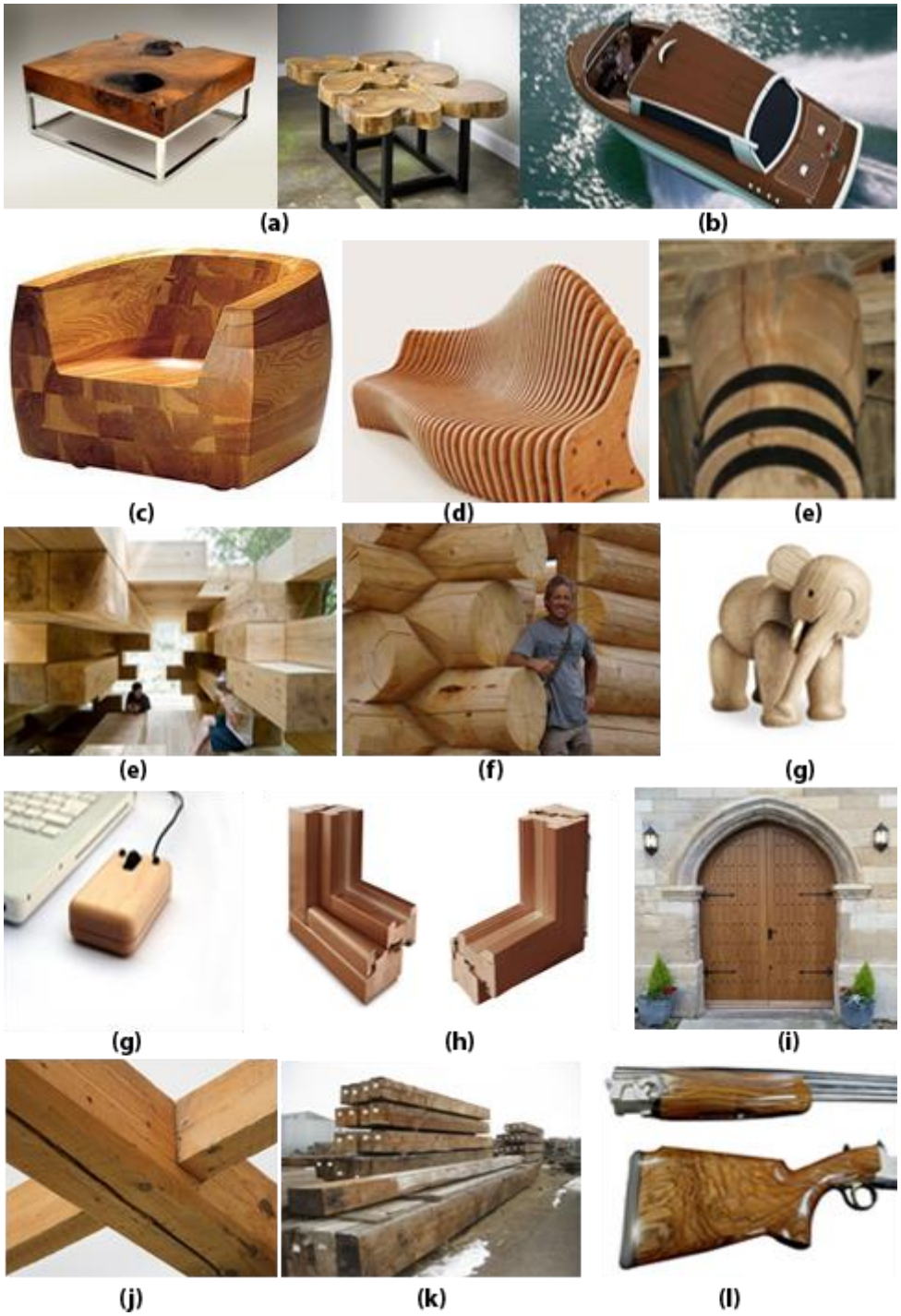

Figure 1. Some samples for value-added and big-sized solid wood products

With all justification, importance and benefits of wood drying should be told:

According to Kantay [1], drying is removing water which is at inside of wood and isn't necessary for intended purpose. Target of an ideal drying is to protect wood quality, to hold drying costs and drying period at minimum level.

Drying provide these benefits; protecting from decaying, limiting shrinkage and swelling, simplification of some woodworks as planing, milling, sanding, perforating etc., improvement of some finishing applications as gluing, painting, waxing etc, improving mechanical strengths and increasing effect of impregnation. First of all, in cases where taking account of weights for shipping, it should be known that carriage of dried wood is cheaper and more riskless [2].

When mentioned-before usage areas are evaluated; moisture content should be app. 10% (even 5%) for not occurring blurring on milling at wooden toys. Moisture contents of parts forming the laminated products as laminated woodworks, big-sized beams, columns and solid wood panels etc. should be too close for bonding quality and stability. Before impregnation process of solid wood (for example which has cross-section dimensions of 30x30 cm and 30x40 cm in size, was made from

one-piece solid Oak and used in docks and log cabin pieces), it should be targeted 19% moisture content level without occurring fissure and split. Also indoor products that natural solid wood tables and wheel-formed coffee tables produced from logs, indoor pieces as load-bearing column and beams in historical buildings should have 12% and below moisture content.

All of these wooden products cannot be dried or desired results cannot be obtained despite drying along months until reaching mentioned moisture content levels with conventional drying methods. At this point, vacuum drying combined with high frequency heating applications is suggested for obtaining minimum drying periods, reaching desired final moisture with protecting material quality.

3 Technical truths about preserving value-added wooden products

3.1 Rapid and Protective Drying

About drying solid woods produced of value-added products which are explained before, different technical drying methods can be used. However, if dried material is stiff, big-sized, if there are drying difficulties due to visual features or if drying by conventional methods requires long periods not enough to be regarded as economic, alternative methods come to forefront. At this point, High Frequency - Vacuum (HFV) combination drying method which uses electromagnetic wave to heat and vacuum drying can be suggested for minimizing drying periods and not occurring quality loss.

Just to clarify the drying process (HFV) more:

While heating starts from surface to inside in available industrial technical drying methods, heating starts from inside at humid areas and it continues to surfaces in HFV method. Thereby heating is faster, drying period is getting shorter considerably with protecting material quality with this process. Heat source in this process is electromagnetic energy received from high frequency generator. Depending on drying environment temperature is low and exterior surface is colder, possible heat loss that transfer from lumber to environment is reduced. If a table is wider than a single column it should be HFV has two application methods in theory: lumber is stable or continuous during the drying. In static method, lumber is generally charged stack formed without stick into a cylindrical autoclave and condenser plates are placed strictly between lumbers at regular intervals, so lumbers are heated with HF. Soon after heating, rapid and foolproof drying is done with vacuum application (Figure 2). In dynamic method, one of electrodes is moving band which carries lumber and other one is stable at above the band.

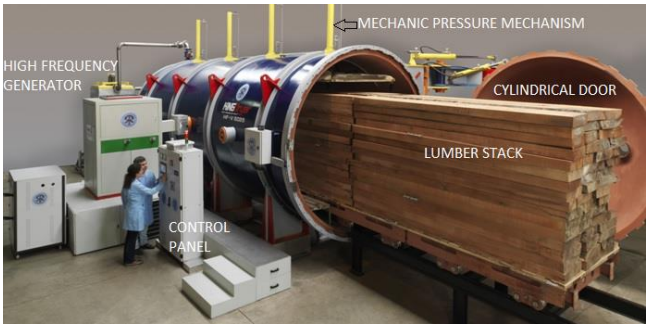

Fig. 2. General view of a high frequency - vacuum combination drying kiln with a capacity 25m³ [3].

When HF-V drying applications are considered generally; heat resource doesn't leave waste so it is a clean and environmentally-friendly process, HFV process obtain energy conservation approximately 40-50% due to don't require to heat kiln equipment and due to humid areas consumes more energy while drier areas less, because of that selective process creates homogeneous drying, operating and maintenance costs are becoming low, less stocking costs and more cash-flow due to short drying periods and with more quality lumbers by comparison conventional methods, although it has risks as occurring honeycombing, color-change and carbonization. Despite all, higher investment costs due to complicated infrastructure and requiring special security measures should be considered [4].

HF-V drying system doesn't require solid and liquid fuel which need high investment costs for heat resource as conventional methods. On the other hand when considering mentioned heat resources can release environmentally hazardous gases, HF-V drying system is more suitable. Pressure mechanism to lumbers from above which is an indoor equipment can prevent deformations and thus drying quality can increase. Stacking without sticks gives chances to increase more lumber charge capacity at the rate of approximately 40%, because of that this advantage provides less operation costs and provides more acceptable especially compared with vacuum drying.

When the results are evaluated about HF-V procedure drying mentioned value-added solid wood products:

According to Güler et al. [5], solid Sapele wood material which has cross-section dimensions of 30x30 cm in size and used in docks' lateral surface for absorbing hit energy of heavy cargo ships, dried from initial moisture 80-90% to final moisture 8-15% with good quality results. Drying period took 228 hours and 2,83 Kwh/kg energy consumed for vaporizing 1kg water (Figure 3). Drying period of 25cm thickness Oak lumbers took 360 hours with same process and moisture levels. Tested dimensional lumbers can not be dried without problems and similar periods in conventional drying methods.

Figure 3. Overview of HF-V dried sapele lumbers [3].

As a continuation of these original studies, Beech, Walnut, Oak and Iroko lumbers with 10 cm thickness were dried with this process for producing natural solid wood table (Figure 4). Lumbers started to drying from high moisture contents until under 10% moisture contents and drying continued between 36 hours and 226 hours. These results show that drying periods can be completed between 1,5 days and 9 days which can take weeks even if months with conventional drying methods.

Figure 4. Boule lumbers after drying; 11cm thickness, width of up to 110 cm and length of up to 5 m [3].

3.2 Thermo Treatment process

Thermo treatment is one of the environmentally friendly methods to improve the properties of wood materials. It was demonstrated that by exposing the wood to temperatures between 170°C to 220°C in absence of oxygen, it is possible to modify components of wood that are susceptible to moisture absorption and biological degradation in nature. Wood after thermo treatment becomes much more dimensionally stable, and the durability for outdoor applications increases from 5 to 20 years if the wood is not in direct contact with the ground [6].

During the thermo treatment process the wood material will be heated to at least 180°C. Steam is used as a safe gas, which protects the wood material from risks of fire. The steam also affects the chemical changes to the wood material during the process. As a result of the thermo treatment as Thermo Wood material is more stable than normal wood and resistance against fungus is better. The thermo treatment darkens the wood color and it is suitable for different applications in interior and exterior use (Figure 5) [7].

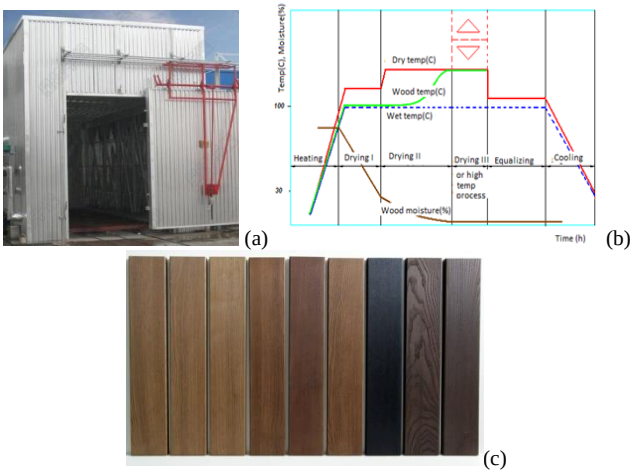

Figure 5. Thermo treatment kiln(a), process(b) and product(c)

Specifically, thermo treatment is a process, which exposes wood to temperatures between 180˚C and 260˚C [8]. Thermo treatments with the use of methods like Plato-Process (Holland), Rectification Process and Bois Perdure (France), OHT Process (Germany) and Thermo Wood Process (Finland) are widely used in European industries. These methods expose wood to temperatures between 160°C and 260°C to increase both dimensional stability and resistance to decay [9].

Despite the aforementioned benefits, thermo treatment can cause many technological alterations in physical, mechanical and chemical wood properties. One example is color, which is characterized as a physical property and, in general, becomes darker in thermally modified wood. This modification can be explained by the formation of products resulting from the degradation of hemicelluloses [10], [11] and of others components such as extractives [12]. The oxidation of products like quinones also contributes for color modifications in wood [9, 13-15].

Moreover, the characteristics of the method such as the atmosphere of treatment, initial moisture content of wood pieces and the equipment used (closed or open system, for example) are very important because they can directly affect the properties of wood.

Thermo treatment beneficially alters several technological parameters of wood. The changes in the physical parameters are due to the significant alterations of the structure and the chemical composition of wood, which take place during the modification process. These changes are complex and some aspects are still far from being completely understood. Various industrially important hardwoods and softwoods have been treated in an autoclave in N atmosphere. The physical (density, L-value, moisture content, bending strength, MOE) and chemical (pH, hemicellulose-, total phenol- and soluble carbohydrate content) parameters have been measured and evaluated. By establishing linear correlations between physical and chemical parameters the chemical changes affecting the physical properties could be investigated and tracked. Very good correlations have been found for hardwood samples, whereas for softwoods only poor correlations have been established. Results could contribute to a better understanding of the reactions of thermo treatment, and could furthermore provide a basis for wood species dependent technology optimization in the future [16].

4 Results and Conclusions

In our country, especially in the last period, trend to natural wood products showed a rapid increase due to different reasons. But it is understood that solid wood has sensitivity in the production and use for having sustainable quality, in other words, to be use without occurring any deformation for long years, we need to gain ground. At this point, some experiences can be showed. For example, big-sized Oak wooden parts which have practice risks, restoration and renovation works in historical buildings at Istanbul, are only one of the similar problems (Figure 6).

(a)

(b)

Figure 6. Case report: Big-sized solid Oak wood application for load-bearing in wooden scaffold project (a) and restoration with laminated Oak woodworks in old buildings in İstanbul (b)

When the considered technical specifications for prepared projects from related municipalities or other official establishments, it is seen that there is no refer to any standard or prepared with insufficient information. For example; in wooden scaffold project, there is a request choosing best quality of Oak wood (which should have high mechanical strength and natural resistance) and it is signified with only "1st class Oak". But which standard of Turkish Standards Institution (TSE) will be referred and correspondingly desired moisture content level should be specified. And it causes to not suitable operations according to technical specifications because of uncertainties and it effects operations negatively. On the other hand, there is only a request about "woodwork profiles should be produced from thermo-treated 1st class Oak according to lamination technique" in old building restoration project. Indeed which standard of TSE will be referred and expectations with moisture content and thermo treatment should be specified exactly.

An example for using solid wood according to technical trues and sustainability quality criteria; reusing impregnated sleepers from solid Oak wood is a weakness for producing and using indoor products even table, coffee table etc. These sleepers were produced for outdoor applications and they produced with impregnation chemicals which have serious health risks for peoples, so it is wrong to be utilized indoor products.

In the vision of all these facts; if it is desired that wood materials for producing value-added solid wood products should service rigidly at usage areas for long years, even if other criteria are fulfilled, it should be dried until moisture levels what requires at usage areas and especially outdoor applications naturally durable wood species or additionally thermo treatment process should be performed. And also proper wood specie should be preferred or process should be investigated with moisture content or stability measurements.

5 Acknowledgements

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