

Jonas VOBOLIS, Darius ALBREKTAS

RESEARCH INTO SORPTION AND MECHANICAL PROPERTIES OF NATURAL AND MODIFIED BIRCH WOOD

The research presented examined wood treatment at high temperatures. Wood specimens were tested at an original working station. In order to increase the durability, environmental resistance and size and shape stability of wood products, the wood underwent a modification process. One modification method included high-temperature heating (140–230°C). Exposure to heat contributed to changes in the chemical composition and physical and mechanical properties of the wood. In addition, assortments of natural and modified birch wood were studied. The sorption properties of the wood were evaluated during the moistening and drying processes. The resonance vibration method was used to assess the modulus of elasticity and the coefficient of damping. The specimens were tested by subjecting them to 3-hour heating at temperatures of 120, 150, 180 and 210°C and soaking them in water afterwards. It was found that the modulus of elasticity of the heated wood increased by 12% and the coefficient of damping decreased by 40%. It was established that the amounts of water absorbed by the heated wood were 5 times smaller in comparison to the natural wood.

Keywords: birch wood, heated wood, coefficient of damping, resonance vibration, modulus of elasticity

Introduction

In order to extend the durability of wood products, to enhance their resistance to environmental stresses and to ensure the stability of their dimensions and shapes, wood undergoes a modification process. One approach involves heating wood at high temperatures (140–230°C). Due to the effect of temperature, irreversible chemical changes occur in the wood. The main components of wood are cellulose and hemicellulose, which constitute 40–50% and 25–35% of wood, respectively.

Darius ALBREKTAS, Kaunas University of Technology, Kaunas, Lithuania,
e-mail: Darius.Albrektas@ktu.lt

Jonas VOBOLIS, Kaunas University of Technology, Kaunas, Lithuania
e-mail: jonvobo@gmail.com

Cellulose forms long chains composed of glucose elements and hemicellulose consists of shorter chains of various monosaccharides [*ThermoWood Handbook* 2003; Huang et al. 2012; Yildiz et al. 2013]. Thermal treatment causes alterations to both groups, however greater changes can be observed in the case of hemicellulose, since it produces acetic acid during thermal treatment. Heat-treated and untreated wood exhibit differences in their content of extractives and other polymers [Huang et al. 2012]. Depolymerization also contributes to a significant decline in the amount of hemicellulose in wood, as it breaks long glucose chains down into shorter chains. A decrease in the amount of hemicellulose leads to a substantial decline in hydroxyl groups which can attract water. Lignin tends to connect wood cells. It contains phenylpropane units which usually form linkage through ether and hydrocarbon bonds. Though lignin is one of the most heat resistant components of wood, bonds between phenylpropane units are partly broken during thermal treatment [*ThermoWood Handbook* 2003; Tjeerdsmā, Militz 2005; Windeisen, Wegener 2008]. Thermal modification changes the sorption properties of wood [Candan et al. 2013]. It is known that when wood undergoes heat treatment, its resistance to harmful insects increases, assortments acquire more stable shapes and its response to the environment becomes diminished [Hyttinen et al. 2010]. In addition, it was established that in contrast to heating untreated wood, the indoor exploitation of heat-treated wood products results in lower emissions of volatile or semi-volatile organic compounds in the air. A number of tests have shown [Gobakken, Westin 2008] that it is unnecessary to cover wood with various chemical materials and oils, and to acetylate it in order to prevent fungal development. It is sufficient to heat wood assortments at a temperature of 200–220°C. One previous study [Younsi et al. 2010] analyzed the effect of heat treatment in order to enhance the stability of wood measurements and the resistance of wood to pests. Applying “Thermowood” technology, the wood underwent heating at a temperature of 180–240°C. All the processes occurring during the heat treatment (heat and moisture migration, and etc.) were described mathematically. There was a good correlation between the theoretical results in relation to these processes and those obtained from the experiments.

There is a close relationship between the strength and density of wood. During the thermal treatment of wood, its density begins to decrease, thus, in some cases it leads to a decline in strength [Tiryaki, Hamzacebi 2014]. In some studies it has been shown that an increase in heating temperature and duration decreased the mechanical properties of wood (MOE, modulus of elasticity by 40%) [Candelier 2013; Korkut 2008]. Increasing the heating temperature from 120 to 180°C, resulted in the MOE of hazelnut wood decreasing from 10–15 to 25–27%. In a temperature 200°C, after 6 h the MOE of spruce decreased approx. 41% but the MOE of beech wood increased 39% after 10 h [Korkut, Hiziroglu 2009]. During heat treatment the compression strength and MOR (Modulus of Rupture) of ash decreased while the MOE increased 4–41% [Yildiz et al. 2013]. However,

in other cases the relationship between mass and strength remained unchanged. In addition, the mechanical properties of wood are highly dependent on the bound moisture content. As a rule, thermally-modified wood has smaller amounts of moisture. The high-temperature treatment of wood (above 220°C) is known to cause greater deterioration in mechanical properties. One study [Gunduz et al. 2009] also examined how temperature affected the mechanical and physical properties of the wild pear tree. After exposing the wood to heating for 2, 4 and 6 h at temperatures of 160°C and 180°C, it was determined that the elastic modulus of wood increased by up to 5%, whereas, the bending and compressive strength decreased by approximately 7.5%. Moreover, this contributed to changes in the wood swelling in various fibre directions, colour and density, and the wood absorbed smaller amounts of environmental moisture. Another work [Gunduz et al. 2008] focused on the Camiyani black pine. The specimens were subjected to heat treatment by alternating the temperature (within a range of 120–180°C) and duration (within a range of 2–10 h). It was found that an increase in heating duration and temperature led to a decrease in wood density, compressive strength, Janka hardness, surface roughness and swelling. Furthermore, the specimens absorbed smaller amounts of moisture and acquired more stable shapes.

Wood is a biological material with a heterogeneous structure. Therefore, during an analysis of its mechanical properties an extensive spread of data is obtained. One possible solution is to use a large quantity of specimens and statistical data processing. Another solution is to apply non-destructive dynamic testing methods for the evaluation of the mechanical properties. The main advantage provided by this method is that the specimens remain intact and can have different dimensions. In addition, the use of dynamic methods for the analysis of specimens allows a quite accurate determination of their elastic modulus and damping coefficient [Santos 2000; Vobolis, Albrektas 2007, 2009; Albrektas, Vobis 2010].

Over recent years, thermal modification has mainly been used for coniferous wood. Birch forests are widespread across Europe, Russia and North America, however birch wood is usually used for particle boards, veneers or, in rare cases, furniture production. The optimization of the thermal modification process of birch wood would allow an expansion in its areas of application and its use in those fields where thermally-modified coniferous wood or more expensive deciduous wood (for instance, ash wood) is used.

The objective of this study was to evaluate how heating temperatures influence the sorption and mechanical properties of birch wood.

Materials and methods

The test involved the use specimens of tangential sections of the wood of one silver birch (*Betula pendula*) tree (fig.1), which grows in the territory of the State

Forest Enterprise of Kaunas City. The specimens were free of knots, sapwood and defects.

In order to ensure a more accurate assessment of the effect of the heating process on the sorption properties of the wood, specimens with similar sorption properties were selected. After completion of the moistening and drying processes, specimens with similar moisture contents were chosen. For this purpose, 120 specimens were selected out of 250 specimens which underwent moistening and drying in the air. The moistening process was carried out in a climatic chamber where the temperature was $30 \pm 1^\circ\text{C}$ and relative humidity was $90 \pm 1\%$. The drying process was carried out in the same climatic chamber where the temperature was $30 \pm 1^\circ\text{C}$ and relative humidity was $30 \pm 1\%$. These processes lasted 168 hours. This allowed the selection of specimens with moisture content differences of up to 1.2%.

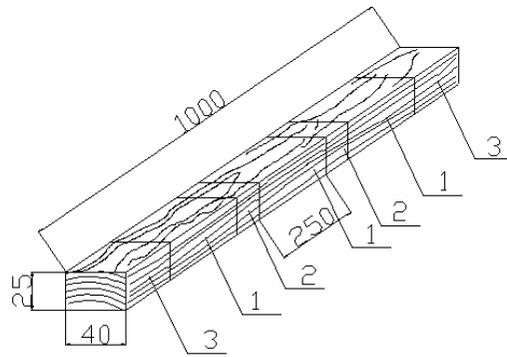


Fig. 1. Scheme of removal of specimens from the wood blank: 1 – specimen; 2 – moisture section; 3 – scrap

After the drying process was completed, the specimens had the following measurements: $250 \times 40 \times 25$ mm. Their moisture contents changed within a range of 6.0–7.2%.

A sliding caliper was used to measure the dimensions (with an accuracy of 0.05 mm in length and 0.01 mm in width and thickness).

The amount of moisture was measured by applying a drying method (Standard LST EN 13183-1:2003). Immediately after the cutting of specimens from the wood blank, moisture test sections (fig. 1, 2) were weighed with an accuracy of 0.01 g and dried at a temperature of 103°C until a steady mass was ensured. The moisture content was calculated according to the following formula:

$$W = \frac{m_w - m_o}{m_o} \cdot 100 \quad (1)$$

where: m_w – the mass of the moist section;
 m_o – the mass of the dry section.

The specimens were also simultaneously weighed (fig. 1, 1) and it was accepted that the amount of moisture contained by a specimen from the same wood blank corresponded to one of the test sections. When the moisture and mass of the specimen was determined, the mass of a completely dry specimen was calculated based on the same formula (1).

After the drying process was finished, the specimens were divided into groups A, B, C, D and G based on their moisture content to ensure that the specimens had a roughly equal average amount of moisture (which was 6.7%). In addition, their viscous elastic properties were established (the modulus of elasticity and the coefficient of damping). An original working station was used for this purpose [Vobolis, Albrektas 2007].

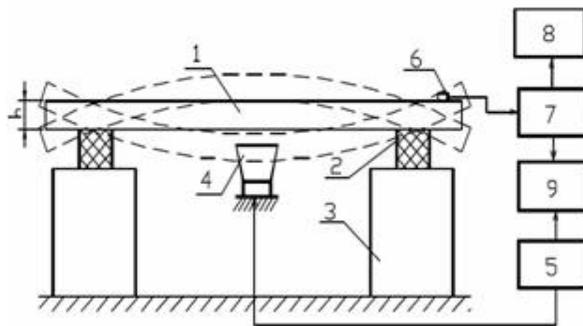


Fig. 2. Scheme of test stand: 1 – specimen; 2 – vibration damping material (foam rubber); 3 – massive supports; 4 – loudspeaker; 5 – vibration generator; 6 – sensor; 7 – measuring instrument; 8 – oscilloscope; 9 – phasemeter; h – thickness of specimen

The tested specimen (1) was placed on elastic elements (2) in a free position. The acoustic vibrator (loudspeaker) (4), which was regulated by the generator of electric signals (5), was used to induce the resonance vibrations of the tested specimen. These vibrations were recorded by the sensor (6) attached to the tested object. By changing the frequency of the generator, the resonance vibrations of the specimen were induced and measured with the measuring instrument (7). The shape of the vibrations was observed on the screen of the oscilloscope (8). To determine the bending direction of the specimen, the phase of vibrations was measured using the phasemeter (9) which received signals from the measuring instrument and the generator.

The viscous elastic properties of the tested specimen were evaluated using a resonance curve, i.e. the amplitude versus frequency response characteristic [Timoshenko 1985].

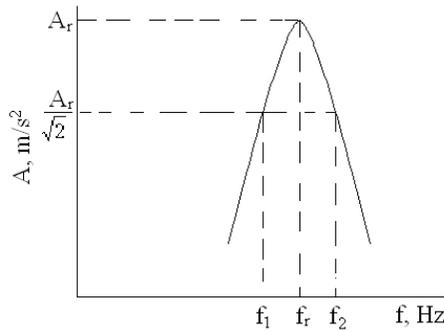


Fig. 3. The amplitude-frequency characteristics of the assortment: where f_r – resonance frequency, f_1, f_2 – frequencies

Its shape predetermined the internal friction – the damping of the specimen. Knowing the resonance frequency f_r and the frequency band width $\Delta f = f_2 - f_1$, it was possible to calculate the indicator of the internal friction (the coefficient of damping):

$$tg\delta \approx \frac{\Delta f}{f_r} \quad (2)$$

where: $tg\delta$ was the general characteristic of the internal friction of the specimen – the tangent of loss angle.

The coefficient of damping is a dimensionless value. Therefore, for the sake of clarity, dimension “relative units” (r.u.) were used.

The modulus of elasticity can be calculated according to the following formula:

$$E = \frac{f_r^2 4\pi^2 \rho s l^4}{IA^2} \quad (3)$$

where: f_r – resonance frequency;

ρ – density of material;

s – cross-sectional area;

l – length of beam;

I – inertia moment of beam cross-section;

A – coefficient characterizing the fastening method of beam ends and modes.

After the evaluation of the modulus of elasticity and the coefficient of damping of the unheated specimens was completed, the specimens in groups B, C, D and G were exposed to 3 hour heating in the air (at 120°C, 150°C, 180°C and 210°C, respectively). The specimens were placed in a chamber and kept under atmospheric pressure conditions. The temperature was maintained with an accuracy

of 2 degrees. The specimens in group A did not undergo heating. After the heating process was completed, the assortments were assessed in order to determine changes in measurements, mass and viscous elastic properties. Then the specimens from each group were soaked in room temperature water under atmospheric pressure for 4 hours while their moisture and viscous elastic properties were recorded on an hourly basis.

Results and discussion

Fig. 4 demonstrates the changes in the mass and volume of the specimens (%) during the heating process.

It can be observed that as the heating temperature continued to increase, the change in the mass and volume of the specimens tended to grow. When the specimens underwent heating at a temperature of 120°C, the average decrease in the mass and volume was 6% and approx. 3%, respectively. When the heating temperature rose to 210°C, the change increased up to 12% and 6.5%. In other studies it was found that thermo – degradation reactions began at higher temperatures, at around 200°C and were fully effective at 230°C (by 12%) [Candelier et al. 2013]. The decline in volume and mass occurred due to the decomposition of hemicellulose and cellulose and the removal of extractive substances and water during the heating process [ThermoWood Handbook 2003; Huang et al. 2012; Tiryaki, Hamzacebi 2014].

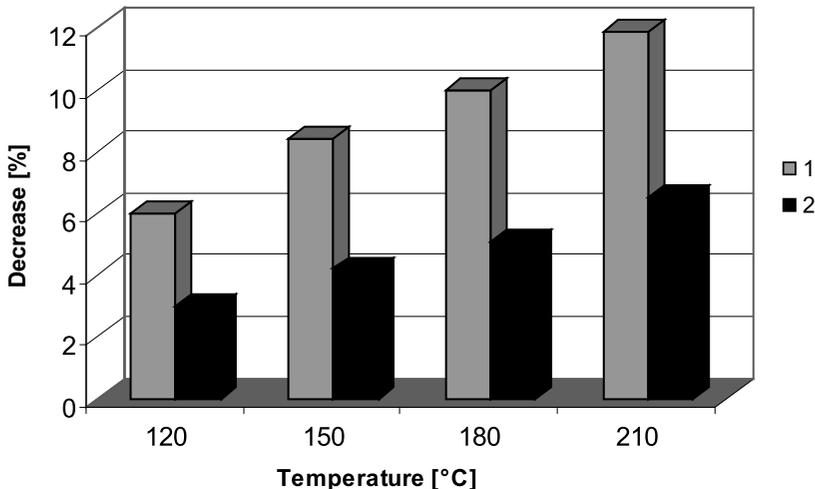


Fig. 4. Changes in the mass (1) and volume (2) of birch wood specimens during the heating process

Fig. 5 shows the changes in the modulus of elasticity and coefficient of damping of the specimens.

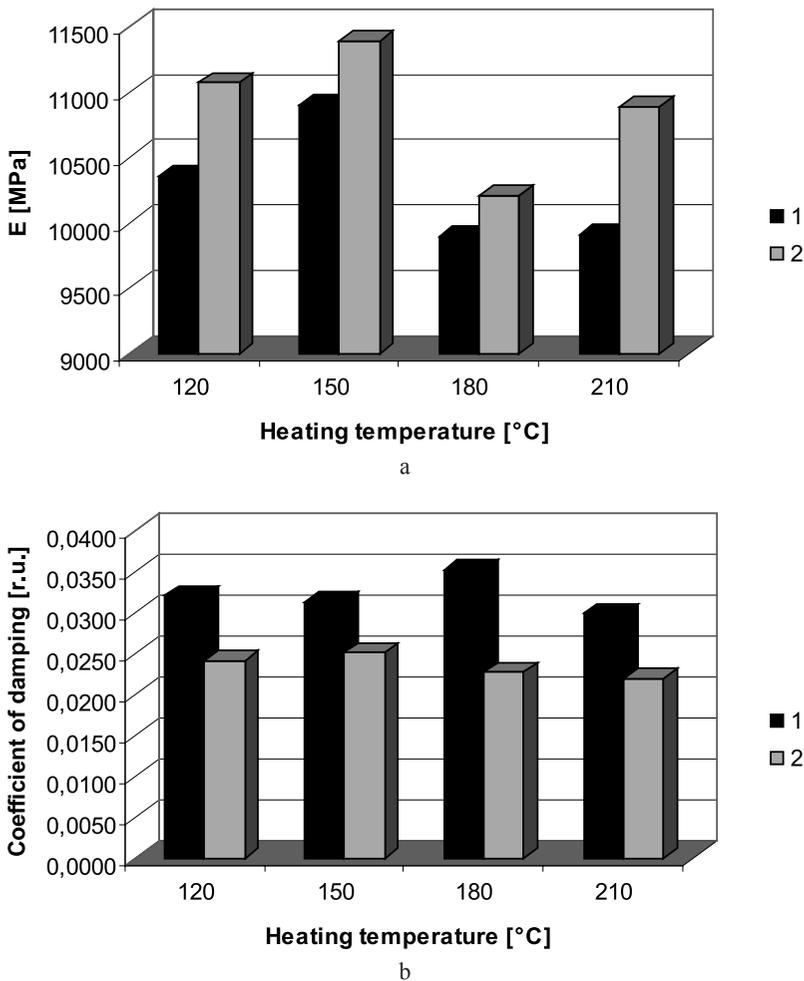


Fig. 5. Changes in the modulus of elasticity (a) and coefficient of damping (b) of birch wood specimens during the heating process: 1 – value before heating; 2 – after heating

It was found that after exposure to heating at a temperature of 180°C, the average increase in the modulus of elasticity of the specimens was 3.1% (from 9899 MPa to 10210 MPa). Meanwhile, when the specimens underwent heating at a temperature of 210°C, the change reached 9.9% (from 9909 MPa to 10895 MPa). The modulus of elasticity of the group B and group C specimens rose by 6.9% and 4.5% on average. Other authors found that the MOE of ash increased 4–41% and the MOE of beech, at a temperature of 200°C, increased 39% after 10 h of heat treatment [Yildiz et al. 2013; Korkut, Hiziroglu 2009]. In this study, it was found that in general, there was a decrease in the average coefficient of damping of the specimens subjected to heating. The smallest change in the

coefficient of damping was recorded in the case of the group C specimens (from 0.0313 to 0.0251 r.u. (19.9%)), whereas, the largest change was observed in the case of the group D specimens (from 0.0352 to 0.0227 r.u. (35.3%). The rise in the modulus of elasticity and the fall in the coefficient of damping can be explained by the reduced density and plastic substances found in the wood [*ThermoWood Handbook 2003*; Gunduz et al. 2009].

Afterwards, the specimens from each group were soaked in water and their volume, average moisture content, modulus of elasticity and coefficient of damping were recorded on an hourly basis. The specimens were soaked for 4 h. This time was sufficient to show the difference in the sorption properties of the wood. Fig. 6 shows the dependence between the average moisture content and the soaking duration.

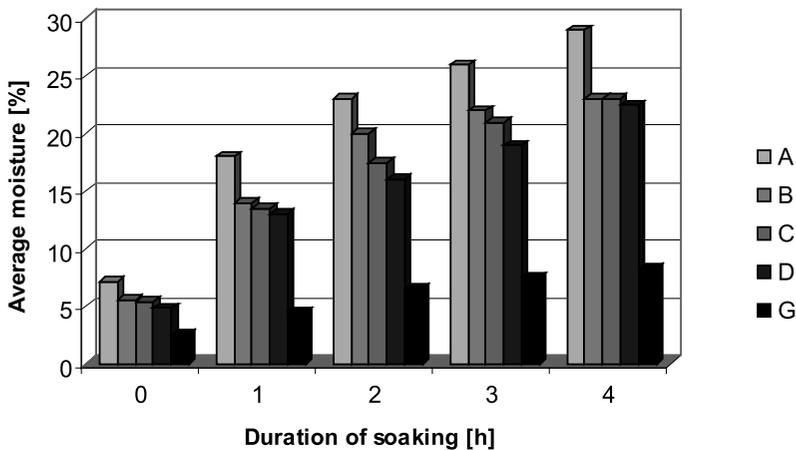


Fig. 6. Changes in the average moisture content of the specimens during the soaking process

It was found that during the soaking process, the largest amounts of water were absorbed by the unheated wood (group A specimens). Before the soaking process, the average moisture content of these specimens was 7.1% and after 4 h of soaking it was 28.5%. In the case of the specimens heated at a temperature of 120–180°C, the wood moisture increased between 5.15% and 22.8%. Meanwhile, when the specimens underwent heating at a temperature of 210°C, the wood moisture rose from 2.5 to 8.2%. Heat-treated and untreated wood exhibited different wetting behaviour due to the differences in the content of extractives and other polymer components induced by the heat treatment. This occurred as a result of the decrease in hydroxyl groups which allowed the wood to attract water [*ThermoWood Handbook 2003*; Huang et al. 2012].

Fig. 7 demonstrates the consistent pattern of volume change during the soaking process.

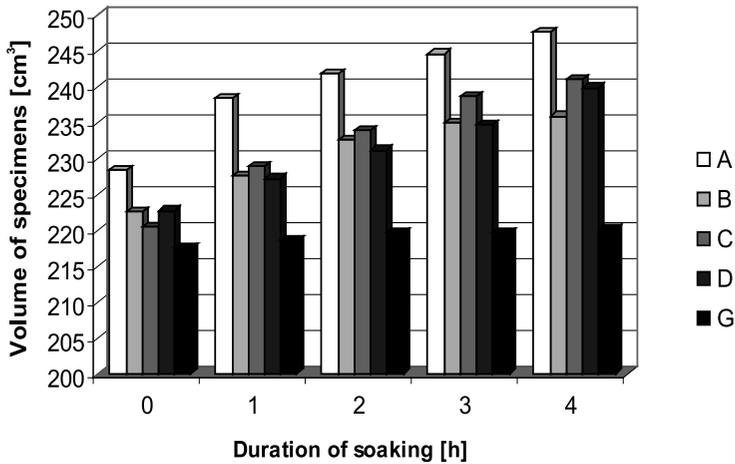


Fig. 7. Changes in the volume of specimens during the soaking process

It was found that the volume of the unheated specimens increased by approximately 8.2% within 4 h, whereas, when the specimens were subjected to heating at a temperature of 120–180°C, the volume rose by roughly 7.65%. The smallest growth in volume (due to the acquired hydrophobic properties) was observed in the specimens exposed to heating at a temperature of 210°C, i.e. up to 1.1% on average.

Fig. 8 reveals the consistent patterns of changes in the modulus of elasticity and coefficient of damping during the soaking process.

It was found that during the soaking process, there was a decline in the average modulus of elasticity of the specimens in each group (fig. 8a). It was established that in the case of the unheated specimens, the average change was between 10350 MPa and 7900 MPa (the difference was 23.6%). When the specimens underwent heating at a temperature of 120–180°C, their modulus of elasticity decreased from 11050–11450 MPa (groups B and C) to 7350–8000 MPa (groups D and C).

It can be observed that after exposure to temperatures of 120°C, 150°C and 180°C, within the 4 h period the modulus of elasticity of the specimens fell by 27.8%, 30.1% and 28.4%, respectively. The smallest decrease in the modulus of elasticity was determined in the case of the specimens heated at a temperature of 210°C, i.e. up to 7.3% (from 10950 to 10150 MPa). This was caused by the amount of absorbed water. the non-heated assortments absorbed noticeably larger quantities of water, which led to a significant increase in their density.

During the soaking process, different patterns of change in the coefficient of damping of the specimens were established. It was found that the coefficient of damping of the unheated specimens declined from 0.0295 to 0.0235 r.u. (constituting a 20.3% change). When the specimens were subjected to heating at a temperature of 120°C, during the first hour of soaking the coefficient of dam-

ping increased from 0.0242 to 0.0420 r.u. and afterwards decreased to 0.0285 r.u. When exposed to heating at a temperature of 150°C, the damping coefficient of the specimens ranged between 0.0250 and 0.0340 r.u. When the specimens underwent heating at temperatures of 180°C and 210°C, their coefficient of damping rose from 0.0230 to 0.0292 r.u. and from 0.0219 to 0.0276 r.u., respectively. This can be explained by the fact that lower temperature heating contributed to the partial breaking of the bonds between the phenylpropane units contained by lignin [Thermo Wood Handbook 2003] and, as a result, the wood became less homogeneous and more ductile. However, it retained a sufficient number of hydroxyl groups which attracted water. Water had no impact on the structure of the unheated wood, and the wood exposed to higher temperatures tended to absorb smaller amounts of water. This is why the coefficient of damping varied within a smaller range in the present cases.

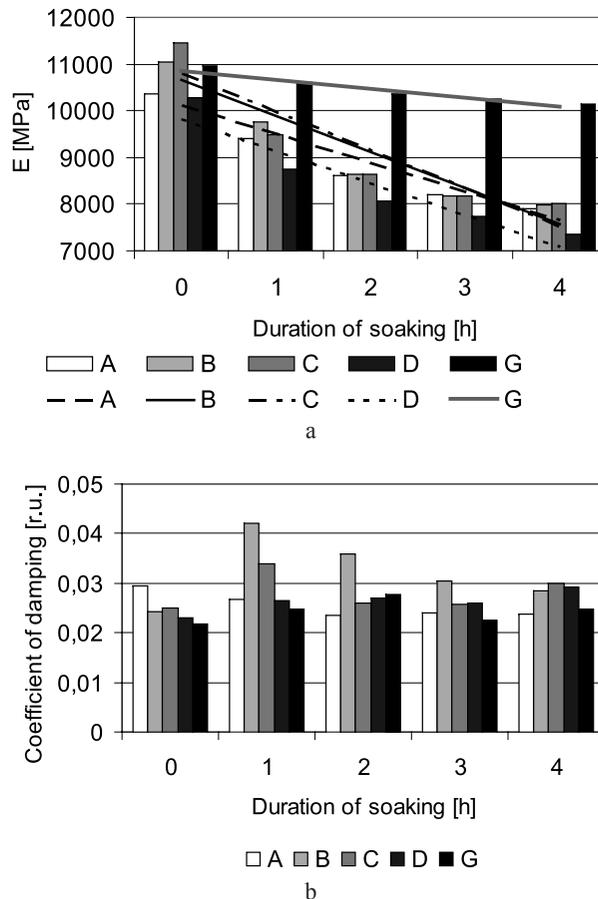


Fig. 8. Changes in the modulus of elasticity (a) and coefficient of damping (b) of the specimens during the soaking process

It was determined that depending on the previous heating temperature applied to the wood, the damping coefficient of the soaked wood changed within a range of 73.6%, 36.0%, 27.0% and 26.0%. It can be observed that in comparison to the unheated specimens, the smallest change in the coefficient of damping occurred when the specimens were heated at higher temperatures and were subsequently soaked in water.

During the drying and heating process, there was uneven distribution of moisture and temperature in the wood assortments, which resulted in the formation of stresses. If they exceeded the strength limit, the wood assortments developed cracks and became unsuitable for production in the majority of cases.

Fig. 9 provides the amplitude-frequency characteristics of some birch specimens after the moistening and heating processes.

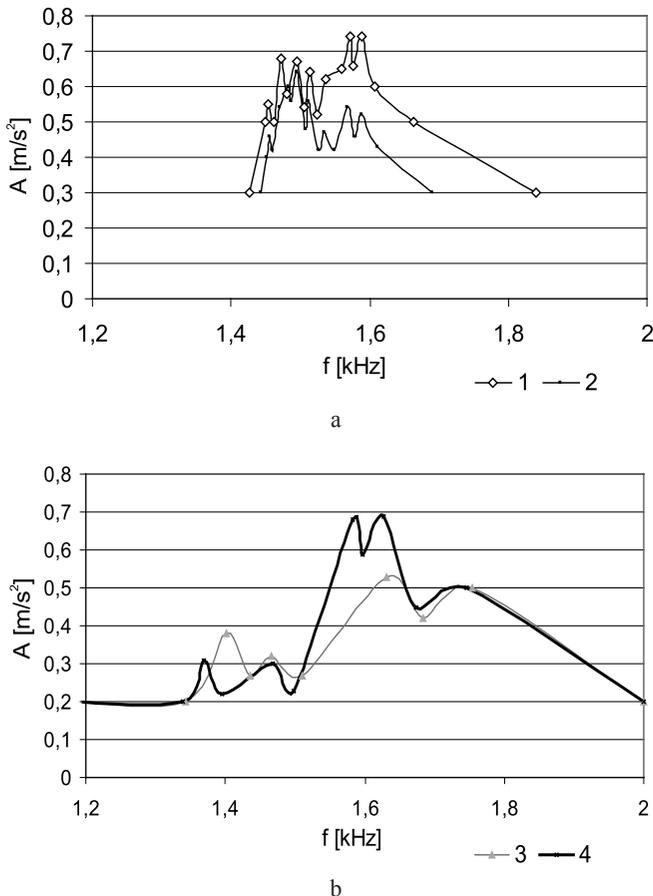


Fig. 9. The amplitude-frequency characteristics of different birch wood specimens (a – specimens 1 and 2; b – specimens 3 and 4) those which cracked during the moistening and heating Process

It can be observed that the amplitude-frequency characteristics of the first, second, third and fourth specimens had the following peaks: 6, 7, 4 and 5, respectively. It is obvious that during the moistening and drying processes, the specimens split into a certain number of separate parts. Due to such amplitude – frequency characteristics, it was not possible to calculate the modulus of elasticity and coefficient of damping.

It can be concluded that the wood showed more stability when it was exposed to higher temperatures. As the ambient moisture tended to vary, the measurements and the elastic and plastic properties of the wood underwent slight changes.

Conclusions

1. It was established that when the birch wood specimens underwent heating at a temperature of 120–210°C, there was an average 4.7% decrease in their volume, a 12% increase in their modulus of elasticity and a 40% decrease in their coefficient of damping.
2. It was demonstrated that in comparison to the non-heated specimens, when the heated specimens underwent soaking in water, they absorbed amounts of water which were 4–5 times smaller and retained a volume which was 6–9 times steadier.
3. It was determined that after 4 hours of soaking, the modulus of elasticity of the non-heated specimens and the specimens heated at up to 180°C and 210°C, declined by 30% and 7.3%, respectively.
4. It was found that there was a substantial rise (up to 73.6%) in the coefficient of damping in the case of the soaked specimens which were heated at lower temperatures (up to 180°C). The coefficient of damping of the specimens heated at higher temperatures (210°C) remained steadier (and changed up to 20.3%) after they were subsequently soaked in water.

References

- Albrektas D., Vobolis J.** [2010]: Testing the effect of transverse resonant vibrations on wood impregnation. *Journal of Vibroengineering* 12 [1]: 50–56
- Candan Z., Korkut S., Unsal O.** [2013]: Effect of thermal modification by hot pressing on performance properties of paulownia wood boards. *Industrial Crops and Products* 45: 461–464
- Candelier K., Dumarcay S., Petrissans A., Gerardin P., Petrissans M.** [2013]: Comparison of mechanical properties of heat treated beech wood cured under nitrogen or vacuum. *Polymer Degradation and Stability* 98: 1762–1765
- Finnish Thermowood Association** [2003]: *ThermoWood Handbook*, Helsinki, Finland
- Gobakken L.R., Westin M.** [2008]: Surface mould growth on five modified wood substrates coated with three different coating systems when exposed outdoors *International. Biodeterioration & Biodegradation* 62: 397–402

- Gunduz G., Aydemir D., Karakas G.** [2009]: The effects of thermal treatment on the mechanical properties of wild Pear (*Pyrus elaeagnifolia* Pall.) wood and changes in physical properties. *Materials and Design* 30: 4391–4395
- Gunduz G., Korkut S., Korkut D. S.** [2008]: The effects of heat treatment on physical and technological properties and surface roughness of Camiyani Black Pine (*Pinus nigra* Arn. Subsp. *Pallasiana* var. *pallasiana*) wood. *Bioresource Technology* 99: 2275–2280
- Huang X., Kocaefe D., Kocaefe Y., Boluk Y., Pichete A.** [2012]: Study of the degradation behavior of heat-treated jack pine (*Pinus banksiana*) under artificial sunlight irradiation. *Polymer Degradation and Stability* 97: 1197–1214
- Hyttinen M., Masalin-Weijo M., Kalliokoski P., Pasanen P.** [2010]: Comparison of VOC emissions between air-dried and heat-treated Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*) and European aspen (*Populus tremula*) wood. *Atmospheric Environment* 44: 5028–5033
- Korkut S.** [2008]: The effects of heat treatment on some technological properties in Uludag fir (*Abies bornmuelleriana* Mattf.) wood. *Building and Environment* 43: 422–428
- Korkut S., Hiziroglu S.** [2009]: Effect of heat treatment on mechanical properties of hazelnut wood (*Corylus colurna* L.). *Materials and Design* 30: 1853–1858
- Santos J.A.** [2000] Mechanical behaviour of Eucalyptus wood modified by heat. *Wood Science and Technology* 34: 39–43
- Tiryaki S., Hamzacebi C.** [2014]: Predicting modulus of rupture (MOR) and modulus of elasticity (MOE) of heat treated woods by artificial neural networks. *Measurement* 49: 266–274
- Tjeerdsma B.F., Militz H.** [2005]: Chemical changes in hydrothermal treated wood: FTIR analysis of combined hydrothermal and dry heat-treated wood. *Holz als Roh- und Werkstoff* 63: 102–111
- Timoshenko S.** [1985]: *Vibration problems in engineering*. Mashinostroenie, Moscow
- Vobolis J., Albrektas D.** [2007]: Analysis of wood peculiarities by resonant vibration method. *Baltic Forestry* 13 [1]: 109–115
- Vobolis J., Albrektas D.** [2009]: The influence of wood structure destruction on viscous elastic properties. *Materials Science* 15 [1]: 53–58
- Windeisen E., Wegener G.** [2008]: Behaviour of lignin during thermal treatments of wood. *Industrial Crops and Products* 27 [2]: 157–162
- Yildiz S., Tomak E.D., Yildiz U.C., Ustaomer D.** [2013]: Effect of artificial withering on the properties of heat treated wood. *Polymer Degradation and Stability* 98: 1419–1427
- Younsi R., Kocaefe D., Poncsak S., Kocaefe Y.** [2010]: Computational and experimental analysis of high temperature thermal treatment of wood based on ThermoWood technology. *International Communications in Heat and Mass Transfer* 37: 2–28

List of standards

- LST EN 13183-1:2003** Pjautinès medienos bandinio drėgnis. 1 dalis. Drėgnio nustatymas džiovavimo metodu (Moisture content of a piece of sawn timber – Part 1: Determination by oven dry method)

BADANIA NAD SORPCJĄ I WŁAŚCIWOŚCIAMI MECHANICZNYMI NATURALNEGO I MODYFIKOWANEGO DREWNA BRZOZY

Streszczenie

Niniejsze badania dotyczyły obróbki drewna w wysokich temperaturach. Próbki drewna zostały przebadane z wykorzystaniem oryginalnego stanowiska badawczego. W celu podniesienia trwałości, odporności środowiskowej oraz stabilności rozmiarowej i stabilności kształtu produktów drzewnych, drewno poddawane jest procesowi modyfikacji. Jedną z metod modyfikacji obejmuje ogrzewanie w wysokiej temperaturze (140–230°C). Podanie działania ciepła przyczynia się do zmian w składzie chemicznym oraz zmian właściwości fizycznych i mechanicznych drewna. Dodatkowo przebadano sortymenty naturalnego i modyfikowanego drewna brzozy. Właściwości sorpcyjne drewna oceniono podczas procesów zwilżania i suszenia. Metodę wibracji rezonansowych wykorzystano do oceny modułu sprężystości oraz współczynnika tłumienia. Próbki przebadano, poddając je 3-godzinnemu ogrzewaniu w temperaturach 120, 150, 180 and 210°C i mocząc je potem w wodzie. Zaobserwowano, iż moduł sprężystości drewna poddanego obróbce termicznej wzrósł o 12%, a współczynnik tłumienia obniżył się o 40%. Ustalono, że ilości wody wchłonięte przez drewno poddane obróbce termicznej były pięciokrotnie mniejsze niż ilości wchłonięte przez drewno naturalne.

Słowa kluczowe: drewno brzozy, drewno modyfikowane termicznie, współczynnik tłumienia, wibracje rezonansowe, moduł elastyczności

