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Colour stability of surface finishes on thermally modified beech wood

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Abstract: *Colour stability of surface finishes on thermally modified beech wood.* The paper deals with the influence of the type of transparent surface finish on the change of colour of the surfaces of native beech wood and thermally modified wood. At the same time, the colour stability of three surface finishes on the surfaces of native and thermally modified beech wood was monitored. Beech wood was thermally modified at temperature of 125 °C for 6 hours. The thermal treatment was performed in a pressure autoclave APDZ 240, by the company Sundermann s.r.o in Banská Štiavnica. Three various types of surface finishes (synthetic, wax-oil, water-based) were applied onto the wood surfaces. The colour of the surfaces of native wood and thermally modified wood was measured in the system CIELab before and after surface finishing; the coordinates L^*, a^*, b^*, C^*_{ab} and h^*_{ab} were measured. From the coordinates measured before and after surface finishing, the differences were calculated and then the colour difference ΔE^* was calculated. Subsequently, the test specimens with the surface finishes were exposed to natural sunlight, behind glass in the interior for 60 days. The surface colour was measured at specified time of the exposure (10, 20, 30, 60 days). The results showed that the colour of the wood surfaces changed after application of the individual surface finishes; and the colour difference reached a change visible with a medium quality filter up to a high colour difference. The wax-oil surface finish caused a high colour difference on native wood and on thermally modified wood as well. On native beech wood, the lowest colour difference after exposure to sunlight was noticeable on the synthetic surface finish. On the surface of wood thermally modified, after exposure to sunlight, the lowest colour difference was noticeable on the surface with no surface finish.

Keywords: beech wood, colour, surface finish, thermally modified wood

INTRODUCTION

Thermally modified wood (TMW) is commonly used for production of floors and paneling for exterior, but also interior. The surface of the TMW needs to be finished with transparent coating materials to preserve the colour and protect the wood surface. Surface finishing is necessary to protect the colour and an attractive appearance of thermally modified wood (Vidholdová et al., 2019). Colour is one of the aesthetic properties that can be identified subjectively with the naked eye, or measured objectively using the spectrophotometer.

Transparent coating is designed to enhance the light stability of the wood surface but not cover the wood texture. Transparent coating films can visibly change the colour of the wood. Change in colour of wood surface after applying a transparent coating material is an interaction of colour of the coating film with the colour of wood surface. Various transparent finishes cause different colour of wood surface (Slabejová and Šmidriaková, 2020). At the same time, the colour of the finished wood surface changes due to sunlight. The change in colour of the surface finish is an interaction of the changed wood colour and the colour of coating film itself. It is generally known that coating films turn yellow under the influence of light.

The impact of transparent finishes on the emphasizing the aesthetic properties of root textures was dealt by Reinprecht and Vidholdová (2011). Colour stability of wood exposed to thermal treatment was evaluated by Kučerová et al. (2019), Lee et al. (2018), and Sandberg et al. (2017). Total colour difference ΔE^* of wood surfaces on native wood of *Acer pseudoplatanus* L. and TMW after coating with three transparent coating materials were evaluated by Slabejová and Šmidriaková (2020). Dzurenda and Dudiak (2020) researched the effect of the temperature of saturated water steam on the colour of wood of *Acer pseudoplatanus* L. Dzurenda et al. (2020) determined the influence of UV radiation on stability of colour of natural and thermally modified maple wood. Research on paint resistance and the total color difference ΔE* on wood surfaces of native wood and TMW is mainly focused on natural aging in outdoor conditions or accelerated aging using xenotest (Nowrouzi et al., 2021; Cirule et al., 2021; Peng et al., 2020; Herrera et al., 2018; Pánek et al., 2017; Kúdela, 2017). In our experiments, the total colour difference ΔE* was evaluated after natural aging in the indoor conditions; surface finishes applied on TMW and native wood were exposed to natural sunlight, behind glass in the interior. It is expected that TMW will be used to produce interior floors and it will be surface finished with common coating materials designed for floors.

In our experiments, the total colour difference ΔE* on wood surfaces of TMW and native wood after finishing with three various transparent coating materials were researched. Subsequently, the test specimens with the surface finishes were exposed to natural sunlight, behind glass in the interior, for 60 days. The surface colour was measured at specified time of the exposure.

METHODS AND MATERIALS

Material

In the experiments, beech wood (*Fagus sylvatica* L.) was used. The test specimens were made from tangential and radial boards:

- native wood (wood without any thermal modification),
- wood thermally modified: at 125 °C ± 2.5 °C for 6 hours (TMW).

Wood was thermally modified with saturated water steam in the pressure autoclave APDZ 240 (Himmasch AD, Haskovo, Bulgaria) in cooperation with Sundermann s.r.o. Banská Štiavnica. The temperature course was as follows: warm-up phase for 1 hour, colour modification with saturated water steam at the temperature of 125 ± 2.5 °C for 6 hours, and cooling down phase for 0.5 hour.

The conditions of thermal treatment to achieve colour modification are described in Dzurenda and Dudiak (2020). The dimensions of the specimens made from thermally modified wood were of 1000 × 100 × 40 mm. The surface of test specimens was grinded with sandpapers with grid numbers of 60 and 80.

Surface finishing process

The following surface finishes for interior use were used:

- Water-based surface finish (Aqua): Transparent water-based acrylate-polyurethane dispersion primer and top coat *Aqua TL-412-TREPPENLACK* on solid wood and veneers, on wooden stairs. Abrasion-resistant finish with a high solids content.
- Synthetic surface finish (Synthetic): Transparent polyurethane coatings material based on a functional acrylic resin *Pur SL-212-SCHICHTLACK*. This coatings material is multi-layer lacquer impresses with its beautiful flow, extreme hardness and scratch resistance as well as excellent adhesion and excellent elasticity. It does not yellow and is resistant to alcohol.
- Wax-oil surface finish (Wax-Oil): Hard, colourless wax varnish designed for protection and decoration of wooden structures in the interior *HWS-112-HARDWOSH-SIEGEL* with natural waxes and oils. Due to the matt appearance of the wood and also in connection with the slip resistance certificate, it is particularly suitable for floors and stairs.

Colour analyse

Colours of the TMW surfaces were analysed according to the CIE *L*a*b** colour system using the colour Reader CR-10 (Konica Minolta, Japan). This device works with a D65 light source by simulating the daylight; its sensor head is 8 mm in a diameter. Colour of wood before and after surface finishing was measured. The colour coordinates L^* (darkness: black (0) – white (100), a^* (– green, + red), and b^* (– blue, + yellow) of each sample were measured in ten places. Measurements were performed on all samples conditioned at the temperature of 20 ± 2 °C and a relative air humidity of 60 ± 5% for 24 hours. The objective assessment of colour response before (index 1) and after surface finishing (index 2) was expressed through the total colour difference ΔE^* calculated according to the following equations:

$$\Delta E^* = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}} \qquad (1)$$

where: $\Delta L^* = L^*_2 - L^*_1$; $\Delta a^* = a^*_2 - a^*_1$; $\Delta b^* = b^*_2 - b^*_1$

L^*_1, a^*_1, b^*_1 coordinate values represent the colour of wood before surface finishing,

L^*_2, a^*_2, b^*_2 coordinate values represent the colour of wood after surface finishing.

The total colour difference ΔE^* can be classified according to the grading rules reported in Table 1.

Table 1. Colorimetric evaluation (Cividini et al., 2007)

$0{,}2 > \Delta E$	Not visible difference
$0{,}2 < \Delta E < 2$	Small difference
$2 < \Delta E < 3$	Colour difference visible with high quality screen
$3 < \Delta E < 6$	Colour difference visible with medium quality screen
$6 < \Delta E < 12$	High colour difference
$\Delta E > 12$	Different colours

The change in wood colour, besides changes in the chromatic coordinates in the CIE $L^*a^*b^*$ colour space, was assessed also following the changes in lightness ΔL^*, chroma ΔC^* and hue angle $h°$ in the CIE $L^*C^*h°$ colour space using cylindrical coordinates. Chroma C^* is an integration of the values of the coordinates of red colour a^* and yellow colour b^* projected onto the chromatic plane of cylindrical colour space. Hue angle $h°$ is expressed in positive degrees starting at the positive a^* axis and progressing in a counter clockwise direction and is described in Dzurenda and Dudiak (2020).

Subsequently, the test specimens with the surface finishes were exposed to natural sunlight, behind glass in the interior, for 60 days. The surface colour was measured at specified time of the exposure (10, 20, 30, 60 days).

RESULTS AND DISCUSSION

In Fig. 1, the change in colour coordinates that occurred after the application of coating materials can be seen. The difference in lightness ΔL^* was always negative; the surfaces darkened both on thermally modified wood and native beech wood, as well. The wood surface with wax-oil surface finish darkened most. Positive changes Δa^* were on all surface finishes on both wood surfaces. The a^* coordinate was in the red area and after applying the surface finishes it was even more pronounced towards the red. Positive changes Δb^* were on both wood types (TMW and native). The b^* coordinate after the application of surface finishes was more pronounced towards the yellow. The greatest Δb^* occurred after applying the wax-oil surface finish. The difference in chroma ΔC^*_{ab} was positive on both wood types. The tested surfaces showed increasing chroma, mostly after applying the wax-oil surface finish. Before application of the coating materials, the surfaces tended more to yellow than to red. The difference in Hue angle $\Delta h°_{ab}$ after application of the coating materials showed that the colour of the surfaces was even more pronounced towards yellow than to red. Similar results are presented in Slabejová and Šmidriaková (2020); the authors researched the change in colour of the surface of wood of *Acer pseudoplatanus* L. and TMW after application of surface finishes. Transparent coatings applied on *Acer pseudoplatanus* L. and TMW caused a negative difference in lightness and positive differences in chroma ΔC^*_{ab} and Hue angle $\Delta h°_{ab}$.

a) b)

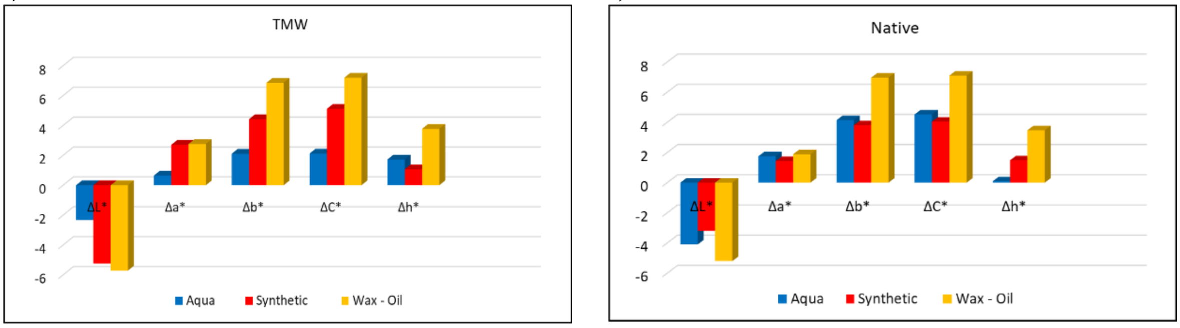

Figure 1. Differences in coordinates ΔL^*, Δa^*, Δb^*, ΔC^*, Δh^* after surface finishing: a) TMW, b) native wood.

The total colour differences of the surfaces (TMW and native wood) after the surface finishes were applied are given in Table 2. The highest colour difference ΔE^*_{ab} was caused by the wax-oil surface finish on thermally modified wood (9.34) and on native wood (8.89), in both cases evaluated as „High colour difference" (according to Cividini et al., 2007). The synthetic surface finish caused the colour difference of 7.37 on TMW (High colour difference) and 5.18 on native wood (Colour difference visible with medium quality screen). The water-based surface finish resulted in the colour difference of 3.21 on thermally modified wood (Colour difference visible with high quality screen) and of 6.08 on native wood (High colour difference). The results show that the total colour difference caused by a surface finish is influenced by the individual components of a coating material and especially by the film-forming component. In Slabejová and Šmidriaková (2020), when testing maple wood, the highest colour difference was caused by a synthetic polyurethane surface finish (High colour difference) and the lowest one by the wax-oil surface finish (Small difference).

Table 2. Colour difference

Surface Finish	Aqua	Synthetic	Wax-Oil
	Colour Difference ΔE^*		
TMW	3.21	7.37	9.34
Native	6.08	5.18	8.89

The following figures show what differences in lightness coordinates occurred and what was the total colour difference of the individual surface finishes during the exposure to daylight in the interior.

Fig. 2a shows that the difference in lightness ΔL^* of all the tested surface finishes on thermally modified wood was increasing. On all the surface finishes, during the first 30 days of exposure, ΔL^* sharply increased and then during the next 30 days it increased milder. On wood surface with no surface finish, the difference in lightness ΔL^* remained almost unchanged from the 30th to 60th day.

On native wood (Fig. 2b), the difference in lightness ΔL^* decreased sharply during the first 20 days of light exposure and reached the lowest negative values. Then it stabilized and remained at a similar value even after 60 days.

These results show that all the surface finishes on thermally modified wood became lighter and the surface finishes on native wood became darker.

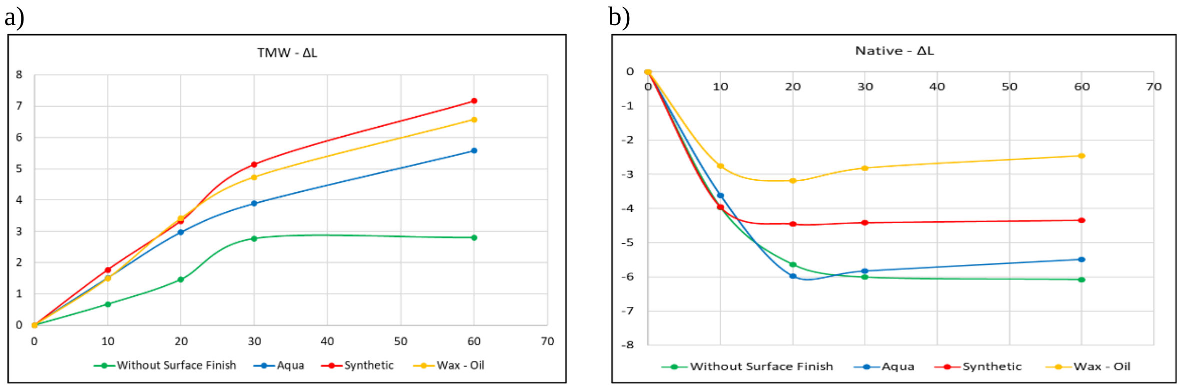

Figure 2. Difference in lightness $\Delta L*$ depending on exposure time: a) TMW, b) native wood.

Fig. 3 shows the total colour difference $\Delta E*_{ab}$. On thermally modified wood, the colour difference increased sharply during the first 30 days of exposure. The maximum value of colour difference (6.77) was noticed on the synthetic surface finish. The lowest value of $\Delta E*_{ab}$ (4.89) was on the surface with no surface finish. After 60 days of exposure, the surface finishes on TMW achieved the following colour differences: no surface finish 5.98 (the lowest value), water-based surface finish 7.33, wax-oil surface finish 8.04, and synthetic surface finish 9.58 (the highest value).

On native wood, the colour difference $\Delta E*_{ab}$ increased sharply during the first 20 days of exposure and reached the following values: wax-oil surface finish 3.91, synthetic surface finish 5.35, and water-based surface finish 6.19. On the wax-oil surface finish, the colour difference dropped slightly between days 20 and 30, reached the value of 3.32, then stabilized and remained the same until the end of the experiment (day 60). The time dependence of the colour difference for the water-based surface finish was similar. After 60 days of light exposure, the surface finishes on native wood showed following values of the total colour difference: no surface finish 8.4 (the highest value), synthetic surfce finish 8.02, water-based surface finish 5.77, wax-oil surface finish 3.18 (the lowest value).

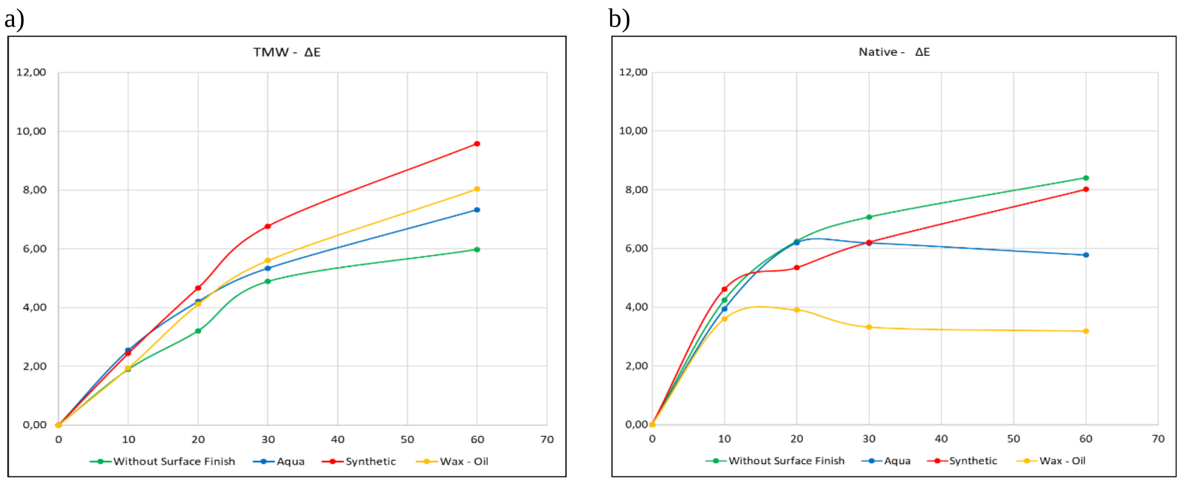

Figure 3. Total colour difference $\Delta E*$ depending on light exposure time: a) TMW, b) native wood.

Fig. 4 shows the difference in chroma $\Delta C*_{ab}$ on thermally modified wood and on native wood during the light exposure.

For the first 10 days, all the surfaces of thermally modified wood showed a negative difference in chroma. Then the difference started rising. After 60 days of light exposure, the surface finishes on TMW showed the following differences in chroma: no surface finish (3.11 – the highest value), synthetic surface finish (2.16), wax-oil surface finish (0.69), and water-based surface finish (0.03 – the lowest value).

On native wood, the wax-oil surface finish showed a negative difference in chroma ΔC^*_{ab} till 20th day and then the difference began to rise. After 60 days of light exposure, the surface finishes on native wood showed the following differences in chroma: no surface finish (5.74), synthetic surface finish (6.66 – the highest value), wax-oil surface finish (1.84), and water-based surface finish (1.78 – the lowest value).

a) b)

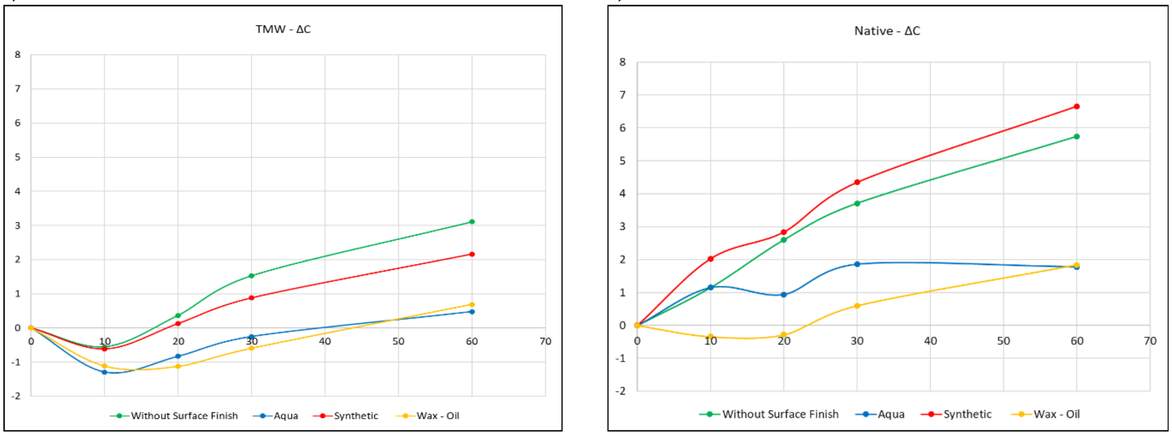

Figure 4. Difference in chroma ΔC^* depending on light exposure time: a) TMW, b) native wood.

Fig. 5 shows the differences in Hue angle $\Delta h°_{ab}$ on thermally modified wood and on native wood during the light exposure.

On thermally modified wood, $\Delta h°_{ab}$ sharply increased during the first 30 days of exposure and then it was increasing milder. After 60 days of light exposure, the surface finishes created on thermally modified wood showed the following differences in Hue angle: no surface finish (10.56), synthetic surface finish (12.37 – the highest value), water-based surface finish (11.21), and wax-oil surface finish (8.83 – the lowest value).

On native wood, the difference in Hue angle $\Delta h°_{ab}$ sharply decreased during the first 10 days of exposure (for water-based surface finish during 20 days) and then the difference was increasing slightly. After 60 days of exposure, the tested surface finishes showed following differences in Hue angle: no surface finish (1.1), synthetic surface finish (1.36 – the highest value), water-based surface finish (-0.01), and wax-oil surface finish (-2.25 – the lowest value).

a) b)

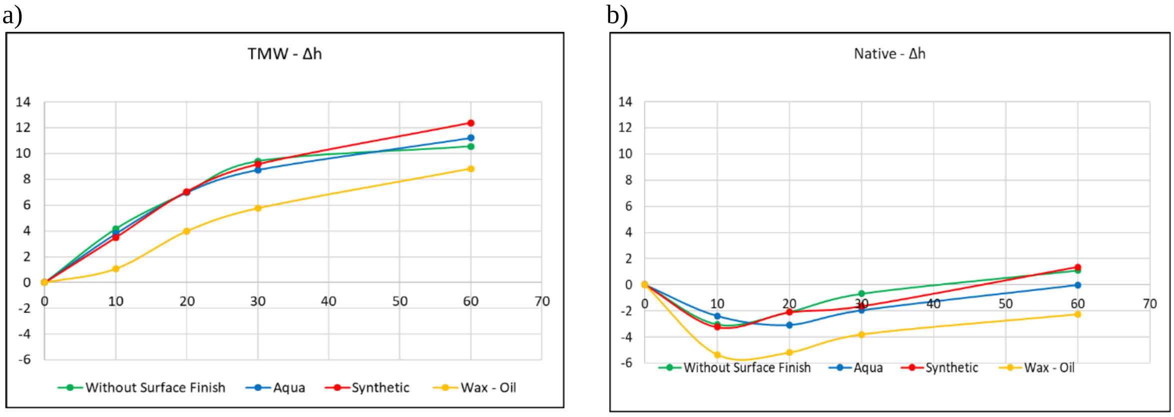

Figure 5. Difference in Hue angle $\Delta h°_{ab}$ depending on light exposure time: a) TMW, b) native wood.

The difference in colour of the surface-finished TMW and native wood is mainly caused by changed colour of the wood substrate. This was also described by Fan et al. (2010), Chen et al. (2012), Olsson et al. (2014), and Kúdela et al. (2020). It is known that different processes of thermal modification and operating conditions (Hill, 2007) causes different changes in chemical composition of TMW (Čabalová et al., 2018; Hrčka et al., 2018).

Forming secondary chromophores leads to yellowing of the wood; and gradual chemical reactions in lignin cause darkening, especially of pale wood types. The important role in the process of changing colour under the influence of light is played by the extractives (Požgaj et al., 1997; Tolvaj and Faix, 1996). The darkening of lighter surface, in our case native wood, is also confirmed by our results. On the contrary, the surface of the TMW becomes brighter under the influence of light. The overall difference in colour of the surface under the influence of light is an interaction of the difference in colour of wood with the difference in colour of the surface coating.

CONCLUSIONS

Based on the results of colour of the tested surface finishes, the following conclusions can be drawn:

- The water-based surface finish caused a lower colour difference on TMW than on native wood. The synthetic and the oil-wax surface finishes caused higher colour differences on TMW than on native wood.

After 60 days of light exposure to daylight:

- When evaluating TMW, the highest colour difference was shown by the synthetic surface finish. The lowest colour difference was noticed on the surface with no surface finish.
- When evaluating native wood, the highest colour difference was noticed on the surface with no surface finish. The lowest colour difference was recorded for the oil-wax surface finish.
- The differences in chroma were lower on the surface finishes applied on TMW than on native wood.
- The differences in Hue angle were higher on TMW than on native wood.

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REFERENCES

1. CIRULE D., SANSONETTI E., ANDERSONE I., KUKA E., 2021: Andersons B. Enhancing Thermally Modified Wood Stability against Discoloration. Coatings, 11(1):81. https://doi.org/10.3390/coatings11010081
2. CIVIDINI R., TRAVAN L., ALLEGRETTI O., 2007: White beech: A tricky problem in drying process. In International Scientific Conference on Hardwood Processing, Quebec City, Canada.
3. ČABALOVÁ I., FAČÍK F., LAGAŇA R., VÝBOHOVÁ E., BUBENÍKOVÁ T., ČAŇOVÁ I., ĎURKOVIČ J., 2018: Effect of thermal treatment on the chemical, physical, and mechanical properties of pedunculate Oak (*Quercus robur* L.) wood. Biores., 13, 157–170. DOI: https://doi.org/10.15376/biores.13.1.157–170
4. DZURENDA L., DUDIAK M., 2020: The Effect of the Temperature of Saturated Water Steam on the Colour Change of Wood *Acer Pseudoplatanus* L. Acta Facultatis Xylologiae Zvolen, 62(1): 19−28
5. DZURENDA L., DUDIAK M., BANSKI A., 2020: Influence of UV radiation on color stability of natural and thermally treated maple wood with saturated water streem.

Innovations in woodworking and engineering desing: International scietific journal, 9, 36-41. ISSN 1314-6149.
6. FAN Y., GAO J., CHEN Y., 2010: Colour responses of black locust (Robinia pseudoacacia L.) to solvent extraction and heat treatment. In Wood Sci. Technol., 44, 667–678. DOI: 10.1007/s00226-009-0289-7
7. HERRERA R., SANDAK J., ROBLES E., KRYSTOFIAK T., LABIDI J., 2018: Weathering resistance of thermally modified wood finished with coatings of diverse formulations. Progress in Organic Coatings, 119, 145–154. https://doi.org/10.1016/j.porgcoat.2018.02.015
8. HILL C. A. S., 2007: Wood modification: chemical, thermal and other processes, 1st ed., John Wiley & Sons Ltd: Chichester, United Kingdom, 239.
9. HRČKA R., KUČEROVÁ V., HÝROŠOVÁ T., 2018: Correlations between Oak Wood Properties. Biores., 13, 8885–8898. https://doi.org/10.15376/biores.13.4. 8885-8898
10. CHEN Y., GAO J., FAN Y., TSCHABALALA M. A., STARK N. M., 2012: Heat–induced chemical and color changes of extractive–free black locust (*Robinia Pseudoacacia*) wood. BioResources, 7(2), 2236–2248. ISSN: 1930-2126
11. KUČEROVÁ V., LAGAŇA R., HÝROŠOVÁ T., 2019: Changes in chemical and optical properties of silver fir (Abies alba L.) wood due to thermal treatment. J Wood Sci, 65, 21. DOI: https://doi.org/10.1186/s10086-019-1800-x
12. KÚDELA J., SIKORA A., SVOCÁK J., 2020: Colour stability of spruce wood surface coated with a polyurethane lacquer without and with a UV absorber admixture. In XIII. Konference pigmenty a pojiva: sbornik / conference preceedings. Pardubice: Chemagazín, 28-30. ISBN 978-80-906269-5-9
13. KÚDELA J., 2017: Accelerated ageing-induced effects on surface properties of wood veneers treated with a modified water-based coating system. Ann. WULS - SGGW, For. and Wood Technol. 98, 59–65.
14. LEE S. H., ASHAARI Z., LUM W. C., HALIP J. A., ANG A. F., TAN L. P., CHIN K. L., TAHIR P. M., 2018: Thermal treatment of wood using vegetable oils: A review. Constr. Build. Mater., 181, 408−419. DOI: https://doi.org/10.1016/j.conbuildmat.2018.06.058
15. NOWROUZI Z., MOHEBBY B., EBRAHIMI M., PETRIČ M., 2021: Weathering performance of thermally modified wood coated with polyacrylate containing olive leaf extract as a bio-based additive. Eur. J. Wood Prod. (2021). https://doi.org/10.1007/s00107-021-01712-3
16. OLSSON S. K., JOHANSSON M., WESTIN M., ÖSTMARK E., 2014: Reactive UV-absorber and epoxy functionalized soybean oil for enhanced UV-protection of clear coated wood. Polym. Degrad. Stab., 110, 05–414. DOI: 10.1016/j.polymdegradstab.2014.09.017
17. PÁNEK M, OBERHOFNEROVÁ E, ZEIDLER A, ŠEDIVKA P., 2017: Efficacy of Hydrophobic Coatings in Protecting Oak Wood Surfaces during Accelerated Weathering. Coatings, 7(10):172. https://doi.org/10.3390/coatings7100172
18. PENG Y., WANG Y., CHEN P., WANG W., 2020: Jinzhen Cao,Enhancing weathering resistance of wood by using bark extractives as natural photostabilizers in polyurethane-acrylate coating. Progress in Organic Coatings, 145, ISSN 0300-9440, https://doi.org/10.1016/j.porgcoat.2020.105665.
19. POŽGAJ A., KURJATKO S., CHOVANEC D., BABIAK M., 1997: Štruktúra a vlastnosti dreva, Bratislava: Príroda a.s., 483. ISBN 80-07-00960-4
20. REINPRECHT L., VIDHOLDOVÁ Z., 2011: Thermowood. Šmíra – Print, s.r.o.: Ostrava, Czech Republic; 89 p.
21. SANDBERG D., KUTNAR A., MANTANIS G., 2017: Wood modification technologies-a review. IForest, 10, 895−908. DOI: https://doi.org/10.3832/ifor2380-010

22. SLABEJOVÁ G., ŠMIDRIAKOVÁ M., 2020: Colour of thermally modified wood finished with transparent coatings. In. Trieskové a beztrieskové obrábanie dreva 2020: vedecký časopis. Zvolen: Technická univerzita vo Zvolene, 97-102. ISSN 1339-8350
23. TOLVAJ L., FAIX O., 1996: Modification of colour by steaming. In.: Proceedings of the 2nd international conference on the development of wood science / technology and forestry. Sopron: University of Sopron, 1–10.
24. VIDHOLDOVÁ Z., SANDAK A., SANDAK J., 2019: Assessment of the chemical change in heat treated pine wood by Near infrared spectroscopy. Acta Fac Xylologiae Zvolen, 61, 31−42. https://doi.org/10.17423/afx.2019.61.1.03

Streszczenie: *Stabilność barwy wykończonej powierzchni drewna bukowego modyfikowanego termicznie*. Artykuł dotyczy wpływu rodzaju transparentnego wykończenia powierzchni na zmianę barwy drewna bukowego niemodyfikowanego oraz drewna modyfikowanego termicznie. Modyfikacja termiczna drewna bukowego przebiegła w temperaturze 125°C przez 6 godzin. Obróbka termiczna została zrealizowana w autoklawie ciśnieniowym APDZ 240 firmy Sundermann s.r.o w Bańskiej Szczawnicy. Na powierzchnie drewna modyfikowanego i niemodyfikowanego naniesiono trzy różne rodzaje wykończeń (syntetyczne, woskowo-olejowe, wodne). Kolor powierzchni drewna mierzono w systemie CIELab przed i po wykończeniu powierzchni; zmierzono współrzędne L^*, a^*, b^*, C^*_{ab} i h^*_{ab}. Ze współrzędnych zmierzonych przed i po wykończeniu powierzchni obliczono różnice, a następnie obliczono różnicę koloru ΔE^*. Następnie próbki testowe z wykończoną powierzchnią zostały wystawione na działanie naturalnego światła słonecznego za szkłem we wnętrzu przez 60 dni. Barwę powierzchni mierzono po określonym czasie ekspozycji (10, 20, 30, 60 dni). Wyniki wykazały, że barwa powierzchni drewna zmieniła się po zastosowaniu poszczególnych rodzajów wykończeń powierzchni; różnica barwy osiągnęła wartości średnie aż do dużych. Woskowo-olejowe wykończenie powierzchni wpłynęło na duże różnice kolorystyczne zarówno na drewnie niemodyfikowanym jak i modyfikowanym termicznie. Na niemodyfikowanym drewnie bukowym, po ekspozycji na światło słoneczne, najmniejsza różnica barwy była zauważalna przy syntetycznym wykończeniu powierzchni. Na powierzchni drewna modyfikowanego termicznie, po ekspozycji na światło słoneczne, najmniejsza różnica barwy była zauważalna na powierzchni bez wykończenia.

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