

Tests of colour change of chosen wood species as a result of UV radiation

MAGDALENA FARFAŁ, ANDRZEJ KĘDZIERSKI

Department of Construction and Technology of Final Wood Products, Warsaw University of Life Sciences – SGGW

Abstract: *Tests of Colour Change of Chosen Wood Species as a Result of UV Radiation.* The influence of UV radiation on the colour change of 7 wood species has been tested. Samples cut out of veneers of the wood species under research were exposed to UV radiation during 2 hours. Samples with and without wax coating were used. The colour of the samples was measured with a spectrophotometer before and after the exposure to radiation and the total colour difference was calculated. The results of the tests showed that the wood of all the species that were tested, whether with or without the protective wax coating, changed their colour as a result of UV radiation. Within the group of samples with no protective coating, the largest colour change was observed in the case of European oak samples, then on the samples of Scots pine, American mahogany, European ash, European cherry, European walnut, and the smallest change – on the samples of fossil oak. Within the group of samples with protective coating, the largest colour change was observed in the case of Scots pine samples, then on the samples of European oak, American mahogany, European ash, European cherry, European walnut, and the smallest change – on the samples of fossil oak. The protective coating of wax improved the resistance to colour change of only two of the wood species. In the rest of the cases it was quite the contrary – it caused bigger colour change in the samples containing wax, in comparison to the samples with no wax. The best protection against colour change was provided by it to the European oak samples, and in the second place - the samples of European ash. The highest increase of colour change in the waxed samples in comparison to the samples with no wax was observed in the case of the protective wax coating applied to fossil oak, then subsequently in the samples of European walnut, European cherry, American mahogany, and the lowest increase: in the samples of Scots pine.

Keywords: wood colour, UV radiation.

RESEARCH SCOPE AND OBJECTIVES

The objective of the work was to study the influence of UV radiation on the colour change of wood. The tests were carried out on the wood samples of European ash (*Fraxinus excelsior* L.), European walnut (*Juglans regia* L.), European oak (*Quercus* sp.), Scots pine (*Pinus sylvestris* L.), European cherry (*Prunus avium* L.), American mahogany (*Swietenia macrophylla* King) and fossil oak (*Quercus* sp.). UV radiation was applied to the samples of the above-mentioned species, both with a protective wax coating and without it.

METHODOLOGY AND RESEARCH PROCEDURE

Four samples with the dimensions of 80 x 140 [mm] were cut from the veneer of each of the wood species under investigation. Two from the samples of each wood species were covered with three layers of wax (wax paste for wood called “Sekret stolarza artystycznego”, natural colour no „6” of the company SINTILOR BLANCHON POLSKA) in intervals of 24 hours. The last layer was manually polished with cotton material. The remaining two samples of each wood species were not covered with wax. For each sample, 4 colour measurements were made with the use of a spectrophotometer of the X-Rite company, model SP60. Afterwards, the samples with and without wax coating were exposed to UV radiation during 2 hours. The lamp of Philips, model HB 171/A, was used. The radiation level stayed within the range between 41 and 47 w/m². After exposing the samples to radiation, the colour measurements were carried out once more on the same areas of the samples.

TEST RESULTS AND THEIR ANALYSIS

The total colour difference ΔE^*_{ab} caused by the exposure to UV radiation was calculated on the basis of the PN-ISO 7724-3 standard: Paints and varnishes – Colorimetry – Part 3: Calculation of colour differences. The following formula was used:

$$\Delta E^*_{ab} = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

where:

$$\Delta L = L^*_T - L^*_R$$

$$\Delta a = a^*_T - a^*_R$$

$$\Delta b = b^*_T - b^*_R$$

The obtained results are presented in Table no 1 and illustrated on Figure no 1.

Tab. 1. Total wood colour difference ΔE^*_{ab}

Wood species	Total wood colour difference ΔE^*_{ab}	
	Wood without wax coating	Wood with wax coating
Scots pine	4,94	4,99
American mahogany	4,02	4,28
European ash	3,09	2,57
European walnut	1,43	2,23
European oak	5,56	4,29
European cherry	2,67	3,29
Fossil oak	0,36	1,89

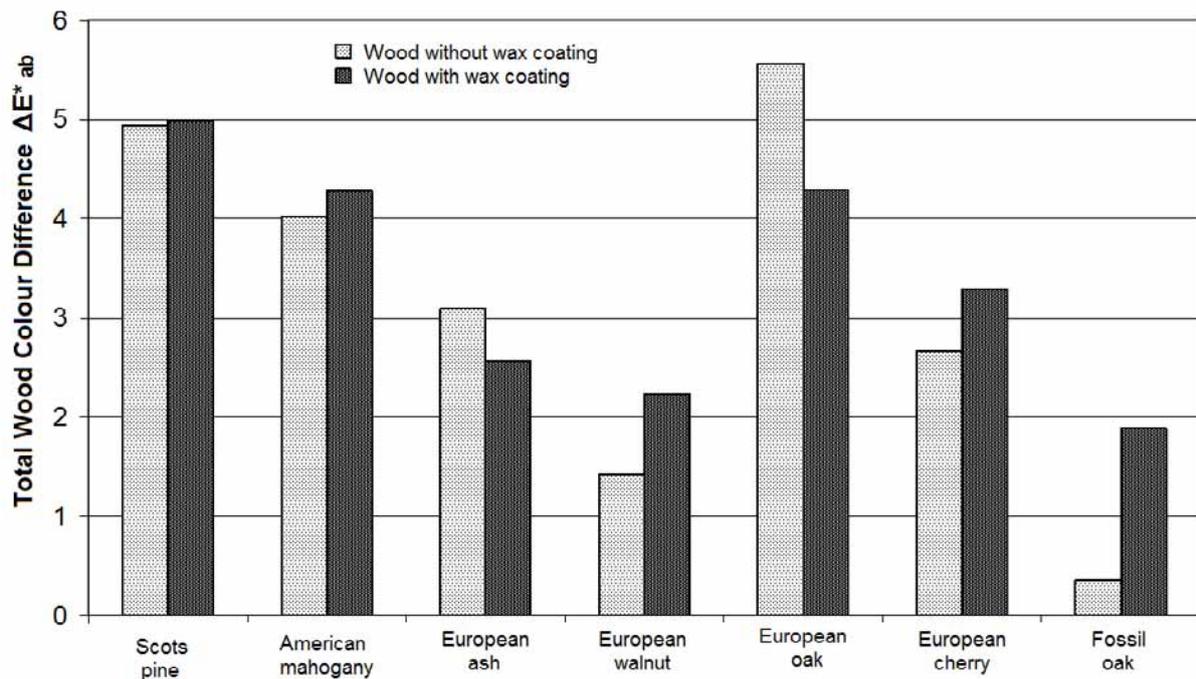


Fig. 1. Total wood colour difference ΔE^*_{ab}

On the basis of the tests that were carried out, we found out that the wood of all the species that were tested, whether with or without the protective wax layer, changed their colour as a result of UV radiation. Within the group of samples with no protective wax coating, the largest colour change was observed in the case of European oak samples ($\Delta E^*_{ab} = 5,56$), then on the samples of Scots pine, American mahogany, European ash, European cherry, European walnut, and the smallest change – on the samples of fossil oak ($\Delta E^*_{ab} = 0,36$). Within the group of samples containing a protective wax coating, the largest colour change was observed in the case of Scots pine samples ($\Delta E^*_{ab} = 4,99$), then on the samples of European oak, American mahogany, European ash, European cherry, European walnut, and the smallest change – on the samples of fossil oak ($\Delta E^*_{ab} = 1,89$).

The protective coating of wax improved the resistance to colour change of only two of the wood species. In the rest of the cases it was quite the contrary – it caused bigger colour change in the samples containing wax, in comparison to the samples with no wax. The best protection against colour change was provided by it to the European oak samples – by 23%, and in the second place, the samples of European ash – by 17%. The highest increase of colour change in the waxed samples in comparison to the samples with no wax was observed in the case of the protective wax coating applied to fossil oak – by 425%, then subsequently in the samples of European walnut – 56%, European cherry – 23%, American mahogany – 6%, and the lowest increase: in the samples of Scots pine – 1%.

CONCLUSIONS

1. The wood of all the species that were tested, whether with or without the protective wax coating, changed its colour as a result of UV radiation.
2. Within the group of samples with no protective coating, the largest colour change was observed in the case of European oak samples, then on the samples of Scots pine, American mahogany, European ash, European cherry, European walnut, and the smallest change – on the samples of fossil oak.
3. The protective coating of wax improved the resistance to colour change of only two of the wood species. In the rest of the cases it was quite the contrary – it caused bigger colour change in the samples containing wax, in comparison to the samples with no wax.
4. The best protection against colour change was provided by the wax coating to the samples of European oak, and in the second place, the samples of European ash.
5. The highest increase of colour change in the waxed samples in comparison to the samples with no wax was observed in the case of the protective wax layer applied to the samples of fossil oak, then subsequently in the samples of European walnut, European cherry, American mahogany, and the lowest increase: in the samples of Scots pine.

REFERENCES:

1. PN-ISO 7724-2 Paints and varnishes — Colorimetry — Part 2: Colour measurement
2. PN-ISO 7724-3 Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences.

Streszczenie: *Badania zmian barwy wybranych gatunków drewna pod wpływem promieniowania UV.* Zbadano wpływ promieniowania UV na zmianę barwy 7 gatunków drewna. Próbki wycięte z fornirów badanych gatunków drewna poddano naświetlaniu promieniami UV przez 2 godziny. Zastosowano próbki z woskową powłoką i bez niej. Zmierzono barwę próbek spektrofotometrem przed i po naświetlaniu i obliczono całkowitą różnicę barwy. W wyniku badań stwierdzono, że drewno wszystkich badanych gatunków drewna, tak z woskową powłoką ochronną jak i bez niej, zmieniło barwę w wyniku promieniowania UV. W grupie próbek bez woskowej powłoki ochronnej największą zmianę barwy stwierdzono na próbkach dębu europejskiego, następnie na próbkach sosny zwyczajnej, mahoni amerykańskiego wielkolistnego, jesionu wyniosłego, czereśni ptasiej, orzecha włoskiego i najmniejszą na próbkach czarnej dębiny. W grupie próbek z woskową powłoką ochronną największą zmianę barwy stwierdzono na próbkach sosny zwyczajnej, następnie na próbkach dębu europejskiego, mahoni amerykańskiego wielkolistnego, jesionu wyniosłego, czereśni ptasiej, orzecha włoskiego i najmniejszą na próbkach czarnej dębiny. Woskowa powłoka ochronna tylko u dwóch gatunków drewna wpłynęła ochronnie na zmianę barwy u pozostałych wręcz odwrotnie – spowodowała wzrost zmian barwy w próbkach woskowanych w stosunku do próbek nie woskowanych. Najbardziej zabezpieczyła przed zmianą barwy próbki dębu europejskiego, następnie próbki jesionu wyniosłego. Największy wzrost zmian barwy w próbkach woskowanych w stosunku do próbek nie woskowanych spowodowała woskowa powłoka ochronna w próbkach czarnej dębiny, kolejno w próbkach orzecha włoskiego, czereśni ptasiej, mahoni amerykańskiego wielkolistnego i najmniej w próbkach sosny zwyczajnej.

Corresponding authors:

M. Farfał, A. Kędziński
Faculty of Wood Technology,
Department of Construction and Technology of Final Wood Products,
159 Nowoursynowska str., 02-776
Warsaw, Poland