Proceedings of the Conference on the Rehabilitation and Reconstruction of Buildings (CRRB 2014)

Edited by
Rostislav Drochytka, Jan Vaněrek and Anna Benešová

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Selected, peer reviewed papers from the
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of Buildings Conference
(CRRB 2014),
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Jan Vaněrek and Anna Benešová**

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Preface

In 1998 in the Czech Republic the Scientific and Technical Association for Building Rehabilitation and Monument Preservation was established as a regional group of WTA e.V. using the abbreviation WTA CZ. The association has held a national conference with international participation every year under the patronage of experts from research and development institutions devoted to the field of structural rehabilitation. The 16th Conference on the Rehabilitation and Reconstruction of Buildings, again featuring international participation, within which new trends and procedures in the field of building rehabilitation were discussed at the international level. The transfer of experience with the rehabilitation of structures and of knowledge regarding the behaviour of materials or the efficiency of methods used in this field is the main benefit for participants in this international conference. In addition, through personal participation authors are able to establish professional cooperation with other participants for their further work or scientific development.

The 16th International Conference on Rehabilitation and Reconstruction of Buildings – CRRB 2014 was held on 5th and 6th of November 2014 in Brno. The conference was hosted by dean of the Faculty of Civil Engineering of Brno University of Technology, Professor Rostislav Drochytka. Conference attended more than 90 participants from six European countries, except for Czech Republic including Slovakia, Germany, Ukraine, Russia and Bulgarian. The conference schedule for the first day was comprised from oral presentations of conference contributions which were divided into seven thematic sections. The next day, the conference program continued with a multilateral discussion on contributions presented in the poster session.

We have to thank all the members of organizing committee for covering the fluent run of the conference, additionally to thank all the members of scientific committee for their professional chairman leading of every speaking sections of the conference program, moreover for their revisions of each contribution to complete peer-reviewed proceedings. Finally, special thanks belongs to all participants, who prepared high quality speeches, presentations and posters, and to guests presenting invited lectures.

On behalf of conference organizers and hosts, we would like to invite all the participants to the next 17th CRRB, which will be held in November 2015 in Prague.

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Application of Colored Impregnating Glazes on Wood And Color Changes due to Artificial Aging

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Keywords: Xenontest, colorchanges, wood, impregnation, artificial aging

Abstract. Wood as organic material is extremely stressed and it is surface may be damaged over time due to atmospheric effects, mainly due to solar radiation and exposure to water. The purpose of this experiment is to compare colour changes of selected impregnation stain the wood, which in practice is primarily used for facade systems. These are among some of the most stressed parts of the building and construction, they must be paid great attention. Wood samples were painted with a colour glaze impregnation and subsequently subjected to artificial aging. The results show that the type of selected species, but also finish before applying a waterproofing glaze can affect subsequent changes light fastness, whether it is a lightening or darkening.

Introduction

Wood is very good absorbent of sun light. This material can absorb not only one type of light but can absorb electromagnetic radiation and this way a photochemical reactions are created, which lead to it is change of colours [1]. The ultraviolet radiation destroying lignin and other components in exterior conditions, which are under the influence of rain, drifted out and causes the loss of colour [2]. These conditions lead to an attack of wood by wood-destroying fungi, cumulating of filth and not least to the loss of natural wood colour [3]. The aim of this experiment is to judge the colour change of impregnation stains applied in three different stains (painting systems) on the chosen kinds of wood for prediction of light intensity in relation with time of artificial ageing with the help of Xenotest Q-Sun Xe-1, which simulates an outside environment UV radiation, by the change of temperature and rain of distilled water.

Material and methods - Samples

For experiments we choose pine wood. The samples were with dimensions 45×40×8 mm (L×R×T) for the artificial aging test device Xenotest chamber Q-Sun Xe-1 modified according to standard EN 927-6. The samples are with no cracks, knots and without sources of resin. After choosing the correct samples we place them in a climate chamber with relative humidity 65 ± 5 % and temperature 20 ± 2 °C. The equilibrium moisture content after conditioning was 12 ± 2 % according to standard STN ISO 554. A combination of coatings is listed in Table 1.

Table 1. Combination of paints used

Samples	**PB(G)1**	**PB(G)2**	**PB(G)3**	**PB(G)9**	**PB(G)10**	**PB(G)11**
Number of coats	1	2	3	1	2	3
Sanding between coats of paint with sandpaper 240	NO	NO	NO	YES	YES	YES
Sample roughened with sandpaper before painting 100	NO	NO	NO	YES	YES	YES

The pine surface was treated with impregnation glaze. We used for experiment two types of paint from the same manufacturer, but in two colours - green and brown. Samples labelled PB(G)9, PB(G)10 and PB(G)11 between coats sanded 240 grit sandpaper to achieve better adhesion disruption of the surface species and the greater receipt.

The aging of samples

The samples for experiment were aged in Xenotest chamber according the modificated standard EN 927-6 [4]. Accelerated aging was carried out in Xenotest Q-SUN Xe-1-S (Q-Lab Corporation, USA) with a xenon lamp 1800 W of power, which can simulate not only sunlight but also can simulate rain, spray of distilled water. The lamp operates in a Xenotest with radiation UVA - 340 nm and a temperature which is determined according to standard EN 927-6. Aging in Xenotest chamber took place in two week cycles. Weekly i.e. 168 hours cycle was divided into phases A – C. The first phase lasted 24 hours and the samples were only exposed to a temperature of 45 ± 3 °C. Avoid water stress or UV radiation. The second phase B 2.5 hours at 50 ± 3 °C, the water spray is turned off and the sample acts UV radiation in the table. After 2.5 hours, turns on the water spray and UV contrast off. The test is conducted in the dark. The temperature drops to 20 ± 1 °C and for 0.5 hours operating on samples of distilled water only. Last 48 hour cycle C is a combination of the second step [4]. According to Hon [5], it was found that the water helps the penetration of electromagnetic radiation into the deeper parts of the wood material.

Measurement of colour changes

With device COLOR reader CR-10 was measured the colour. Values have been recorded before entering into Xenontestu and then in a weekly cycle at the completion of one part of the test. To the determination of hue and lightness are used CIE LAB - L*a*b* colour coordinate system according to ISO 7724 CIE Lab system. It was found that a small change in colour or colour stability of the coating exists when $\Delta E^* \leq 2$, the apparent colour change ΔE^* at 2 to 12, while $\Delta E > 12$ colour changes are very pronounced.

Results and discussion

In the Table 2 we can see the colour changes of wood surface treatments on pine. Positive values (plus) indicate increase Δb yellow and negative values shift to the colour blue. Positive values indicate a tendency Δa wood finishing move your colour under the trichromatic coordinates toward reddish tones, while negative values show a shift to green tones. The results show that the greatest shift the coordinate Δa for pine (*Pinus* L.) painted brown coating exhibits comp PB1, and the initial value of this sample was a* = +15.1 at time T0 and after accelerated aging showed a * value = -8,1 at time T2. Here, the colour shifted from red to green tones (Fig.5). The largest shift of value Δb for the sample PB1 with a brown colour, where Δb = 7,1 and the colour shifted from blue to yellow shade. The smallest was for the sample PB11 where Δb = 0,1 and the colour has not changed significantly. Similar values we have noted with the samples painted with green colour. The largest value of ΔL, thus brighter colour of sample, exhibits PB2 sample (two layer painted sample) which is Δl = 5,6. In this case, the colour shifted to the brighter shade. The smallest value Δl = -1,0 (darkening of the sample) of the sample PG10 coated with two coats, but in this case with sanding applied between the coats. The results show that the samples that were treated by sanding before they were coated a colour fastness occurs. For samples that were not treated before coating the surface, it occurs in dependence on time for colour fading. Among samples PB1-3 and PG1-3 are ΔL values greater than in the samples PB9-11 and PG9-11 which were sanded with sandpaper.

Table 2. Difference values of L *, a *, b * at time T0 and T2 for pine wood with brown colour

Colour	Brown											
Time	**T0**						**T2**					
Label	PB1	PB2	PB3	PB9	PB10	PB11	PB1	PB2	PB3	PB9	PB10	PB11
L*	40.7	28.7	27.6	29.6	26.3	26.4	42.2	34.2	32.3	29.1	27.4	27.3
a*	15.1	5.1	1.6	5.1	2.2	1.9	5.0	0.9	0.7	5.0	1.6	1.6
b*	7.9	3.2	1.1	5.7	4.1	1.2	15.0	8.1	3.5	6.1	4.3	1.3

Table 3. Difference values of L *, a *, b * at time T0 and T2 for pine wood with green colour

Colour	Green											
Time	**T0**						**T2**					
Label	PG1	PG2	PG3	PG9	PG10	PG11	PG1	PG2	PG3	PG9	PG10	PG11
L*	36.8	32.9	30.0	40.0	32.7	28.9	40.0	35.6	32.2	39.3	31.7	28.2
a*	-8.1	-7.7	-7.3	-7.7	-7.9	-5.3	-7.0	-6.8	-5.2	-7.5	-7.5	-5.2
b*	10.7	6.3	2.7	15.2	8.0	4.0	14.3	7.5	3.4	16.2	7.5	2.9

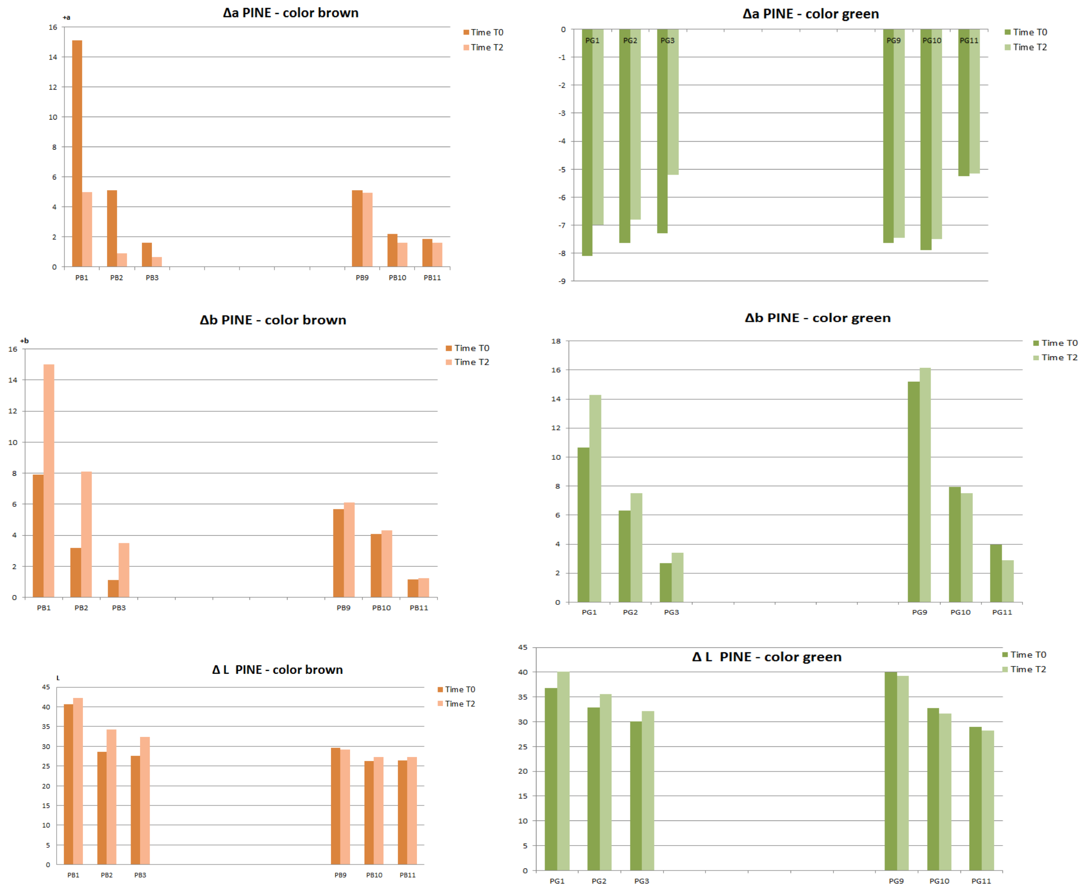

Fig. 1 Variability and the shift of the colour space ΔL, Δa, Δb in time T0 as well as ageing pine wood samples in time T2. The value ΔL closer to zero means darkening of colours.

Due to the two-week exposure in aging accelerators darkened colour most of the samples labelled PB2, i.e. for samples, which were selected in the impregnating finish without sanding individual layers. The smallest change in colour exhibited samples PB9 where ΔL = -0.5 and PG11 ΔL = -0.7. Where is surface before applying the finishing roughened, and the interlayer brushing. The samples of pine, green colour darkened with time, while the brown brightness. It has been shown that certain types of finishes may darken first, before it lightens, which describe Hon (1973), and this would explain the darkening of brown colour- paint. A prerequisite would be that a longer period of time when exposed to the samples in the Xenotest chamber occurred lightening.

Table 4. Colour changes of pine wood exposed to accelerated weathering test. Minuz before the number ΔL indicates darkening.

Pine	Brown						Green					
Label	PB1	PB2	PB3	PB9	PB10	PB11	PG1	PG2	PG3	PG9	PG10	PG11
ΔL	1.5	5.6	4.7	-0.5	1.1	0.9	3.4	2.8	2.2	-0.8	-1.0	-0.7
Δa	-10.1	-4.2	-1.0	-0.2	-0.6	-0.3	1.1	0.9	2.1	0.2	0.4	0.1
Δb	7.1	4.9	2.4	0.4	0.2	0.1	3.7	1.2	0.7	0.9	-0.5	-1.1
ΔE	12.4	8.5	5.4	0.7	1.3	0.9	5.1	3.1	3.1	1.2	1.2	1.3

Conclusion

The results of exposure to artificial weathering showed that the colour stability, evaluated according to the CIE L* a* b* system under evaluation ΔL*, Δa*, Δb* and ΔE * was better at the samples, which were grinded between coatings. In combination of distortion wood grinding before and after deposition of stains would explain the increased transfer of moisture and thus the leaching of colour pigments. In this experiment, we confirmed that each coating behaves differently in different types of wood. The fewer layers applied on the wood surface, the more we can expect loss of colour. Influence on changes surface and ageing of wood surface, have not just the kind of wood, but the whole conditions and way of finish. With a good surface finish it is possible to prolong durability of wooden facade systems. During the process of choosing wooden facade it is necessary to focus on right choice of wood and regular wood protection. We must adopt fact that ageing is natural, and is impossible to avoid them, but we can eliminate the bad results of natural aging paint finish right.

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