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# Comparison of test methods for coatings on wood

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**Abstract:** The article compares two different testing methods of color changes of wood coatings with varying pigment content and varying surface quality before finishing. For both Xenotest as well as Exterior testing method were set up same conditions of wood surface and all samples were coated by the same amount of paint in three layers. Three different shades of paints were tested and then compared to reference sample without any finishing paint. We also tested influence of girt size to divergence of methods by using two different sizes of abrasives for preparation of finishing. Xenotest method is faster and has only slight differences in pattern of changes in comparison to exterior method but only in case of pigment paints. When transparent finishing patterns of changes were compared differences of methods were increasing while surface quality had very significant influence to color changes in case of Xenotest. To compare and predict quality of paint systems is more suitable to use faster Xenostest but on the other hand for obtaining exact values of color changes long term exterior tests are needed.

*Keywords:* Paints and varnishes, UV chamber, wood colorfastness, xenotest

## INTRODUCTION

Coating systems allow to increase the natural durability of wood and wooden products exposed outdoors or installed in the interior. Mainly used are coating systems based on acrylic, alkyd, oil paints, but also other kinds. Their role is mainly to prevent the occurrence of cracks and to limitate color changes. The exterior surface layers are particularly exposed to atmospheric influences such as solar radiation and its components (UV, infrared, visible light, etc..), water (water, atmospheric moisture, snow, ice), changes in temperature, dust particles in combination with flow air emissions and other (Reinprecht 2008). Often are wood and wood-based products attacked by wood decaying fungi, mold or wood-destroying insects (Stejskal 1994). Color changes in the surface layers are the most important in the interior. Coatings then fill mainly function as components of solar radiation absorption, prevent the effects of moisture, accidental exposure to water and provide protection against abrasion there.

Wood coatings are usually tested in accordance with EN 927-3 (natural ageing in the exterior), EN 927-6 (accelerated aging in UV chambers with water spraying) and for accelerated aging in the interior by UV chambers are used procedure established by EN 15187.

Not yet completely solved problem is a comparison of exterior and accelerated (which allow a significant reduction of testing time) testing methods according to EN 927. In the article, a specific example of a synthetic polymer paint was tested by both methods and differences in color change during the test were evaluated and compared.

## MATERIAL AND METHODS

Samples from norway spruce (*Picea abies*, Karst, L.) with moisture w = 8 ± 2% were abraded with sandpaper in one case with 60 grit (also labeled as "rough"), in the

second case with 120 grit (also labeled "smooth "). Subsequently technology of spraying was used for deposition layer of coating (120 g / $m^2$)

1. Layer SunCare 900 – base layer
2. Layer WoodCare UV LL (long life) – tested coating system
3. Layer WoodCare UV LL (long life) – tested coating system

Shades of coating WoodCare UV LL used in the test were Transparent, Pine and Larch.

After seasoning of the coating, the test samples and reference samples (unpainted) were exposed for 3 years outdoors (in an urban environment with temperature fluctuations from -30 ° C to + 35 ° C during the test) on the base of EN 927-3 in the stands with 45 ° angle. The second set of test samples was tested in Xenotest Q-Sun Xe-1-S on the basis of EN 927-6, for 12 weeks. Comparison of color changes of paint and untreated wood was done in the exterior after the 1st, 3rd, 6th, 12th, 24th and 36th months and in a Xenotest after the 1st-12th weeks, once per week. The color was measured by Color Reader CR-10 (Konica Minolta, Japan) and evaluated in CIELab scale (CIE 1986, ISO 7724) on the basis of a parameter change ΔE (total color change , when ΔE> 3 is the color change observable with the naked eye, when ΔE ≥12 it is defined as a different color)

## RESULTS AND DISCUSSION

The results of our testing showed changes of samples color when testing outdoors, (see Fig. 1) and the testing took place in Xenotest color changes according to Fig. 2

Fig. 1: Changes ΔE during the test in accordance with EN 927-3 in exterior

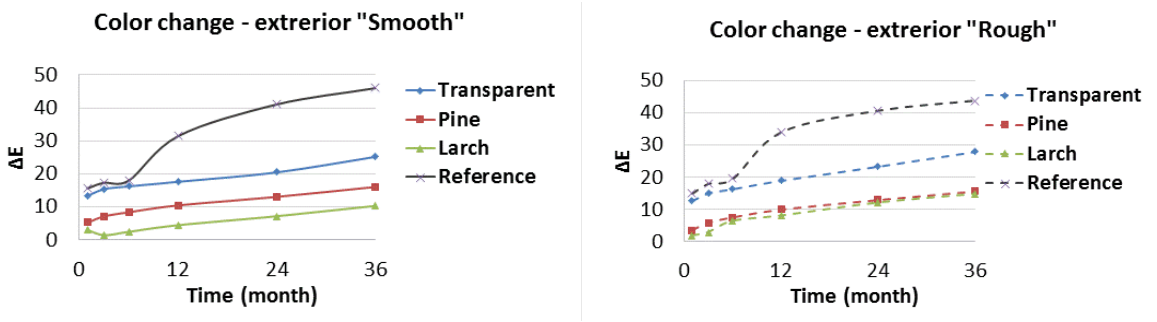
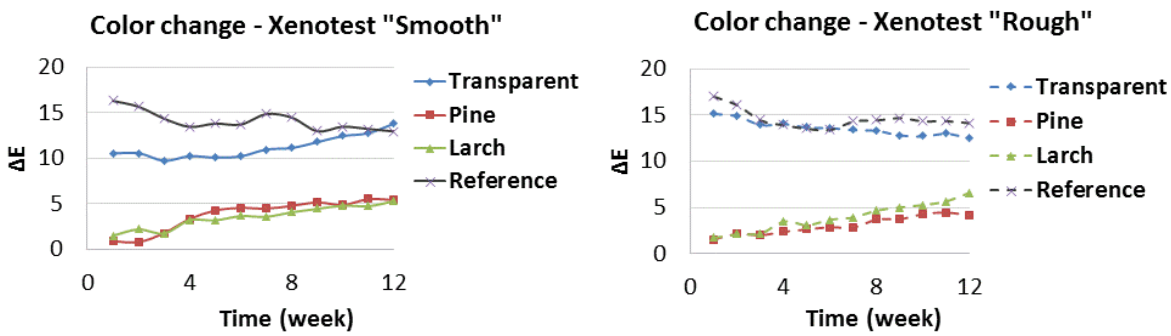



Fig. 2: Changes ΔE during the test in accordance with EN 927-6 in Xenotest



Comparing of images it is evident that changes of color of test samples were carried out differently in the exterior and in the Xenotest. The biggest difference was observed in testing reference samples (unpainted), which was mainly influenced by dirt particles in the porous structure of wood in outdoor exposure. Comparison of samples treated with coating system demonstrates highest color changes in paint "Transparent", significantly lower than pigmented, both in the exterior and also in Xenotest. An interesting difference was between color changes of transparent and of pigmented coatings in Xenotest.

Pigmented coatings had change of ΔE approximately the same as in the exterior, but in the case of a transparent coating in Xenotest differed significantly. The most significant changes in Xenotest already occurred in the first week of the test, as well as changes in values has gradually declined. It is also noticeable impact of dirt influence into the surface layers of the coating during outdoor exposure. Different changes were also higher due to the roughness of the substrate (rough surfaces had average higher and faster growth of ΔE).

Pictures of samples (for illustration only - different lighting conditions at the time of shooting) taken in time of color measurements during testing are shown in Foto 1 and visually demonstrate changes of colors. The most significant difference based on color changes was observed between reference samples (unpainted) and samples "Transparent" in the exterior and in Xenotest.

Based on the above illustrative example of testing of the coating system, it is obvious that the color changes of the surfaces of the painted material (in our case, spruce) have a different course in the exterior and during accelerated aging in the Xenotest. The results demonstrate the importance of paints for saving of wood color and for slowing of its changes, (see Fig. 1, Fig. 2 and Foto 1).

They also show a comparison of changes due to different roughness of input material. Wood as a porous material captures dust particles in its structure and other impurities that in combination with the color change caused by atmospheric agents (sun, water, etc.). In a relatively short period of time cause its grey shade. At present, such timber is sought by some designers for its plastic textured.

However, the producer who wants to keep the original, or the chosen color of the wood is forced to use an appropriate transparent or pigmented coating. Comparison of the two testing methods in our earlier works (Reinprecht et al 2011; Reinprecht, Panek 2013; Panek, Reinprecht 2013) have shown that in most cases it is possible to evaluate the level of quality and color stability of coating systems for testing in Xenotest. However, the specific value of color changes ΔE is different after testing in exterior.

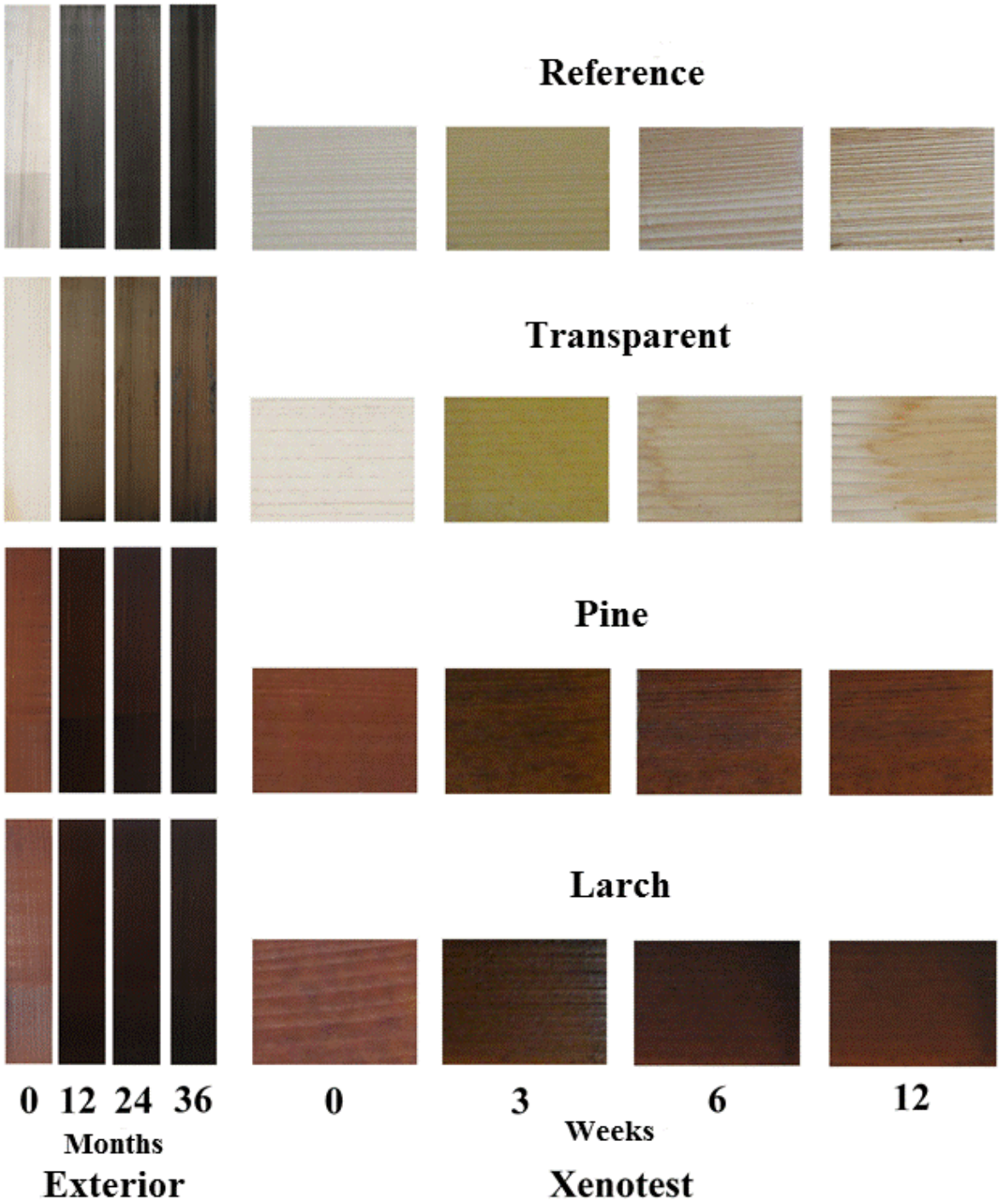
The deviation will vary by location of testing, the amount of air pollutants and dust particles in the air and will depend on the specific climatic conditions at the site during the test. Different results are obtained in the mountains with a higher proportion of UV radiation and a lower proportion of air pollutants and the other in an urban environment with the opposite ratio factors. Testing in Xenotest in contrast, provides a single standard that can be observed in different laboratories anywhere in the world.

## CONCLUSIONS

For the manufacturers and also the customer can test results in Xenotest predict the quality of a particular coating system in comparison with others. The advantages are that the results are obtained in the order of weeks and repeatability of the tests under the same conditions. Specific values of the colors changes needed long-term tests lasting for

years and even the order may vary depending on location and time of exposure in the exterior. We don't known any coating system in which color of surfaces stay completely unchanged during exterior exposition, but many of them significantly reduce color change after a period of use. Good coatings can prolong aesthetic and functional product quality during service-life from years to several decades with repeated renewal of the coating.

Foto 1: Samples tested in exterior (4 on the left side) in the course of 36 months and in Xenotest (4 on the right) during 12 weeks.



REFERENCES:


1. CIE (1986). Colorimetry. 2nd Edition, CIE Pub. No. 15.2. Commission Internationale de l'Eclairage, Vienna, 74 s
2. EN 927-3 (2000). Paints and varnishes – Coating materials and rating systems for exterior wood – Part 3: Natural weathering test, *European Commmitee for Standardization,* Brussels
3. EN 927-6 (2006). Paints and varnishes – Coating materials and rating systems for exterior wood – Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water, *European Commmitee for Standardization,* Brussels
4. EN 15187 (2006). Furniture – Assessment of the effect of light exposure, *European Commmitee for Standardization,* Brussels
5. ISO 7724 (1984). Paints and varnishes – Colorimetry, *International Organization for Standardization,* Switzerland
6. PÁNEK, M., REINPRECHT, L. (2013). „Comparison of natural exterior and artificial Xenotest ageing of selected paints on spruce wood from the point of view of their colour changes," In: *COST Action FP 1006, 3rd Workshop –"Process and Service life modeling*," April 17 – 19, Ghent, Belgium, Abstract 2 p.
7. REINPRECHT, L. (2008). „Ochrana dreva. (Protection of wood)," TU in Zvolen, 453 p.
8. REINPRECHT, L., BACULÁK, J., PÁNEK, M. (2011). „Prirodzené a urýchlené starnutie náterov pre drevené okná = Natural and accelerated ageing of paints for wooden windows," In: *Acta facultatis xylologiae Zvolen*, TU in Zvolen, 53(1), 21-31.
9. REINPRECHT, L., PÁNEK, M. (2013). „Vplyv pigmentov v náteroch na prirodzené a urýchlené starnutie povrchov smrekového dreva = Effect of pigments in paints on the natural and accelerated ageing of spruce wood surfaces," In: *Acta facultatis xylologiae Zvolen* TU in Zvolen, 55(1), 71-84.
10. STEJSKAL, V. (1994). „Moli, červotoči a jiní škůdci materiálů v domácnostech, skladech a chalupách," Praha, SCRIPTUM spol. s r. o., 56 p.



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**Streszczenie**: *Porównanie metod badania powłok na drewnie.* W artykule porównano dwie różne metody badań zmian kolorystycznych lakierów do drewna o różnej zawartości pigmentu i różnej jakości powierzchni przed wykończeniem. Dla obu metod. Xenotest oraz zewnętrznej, stworzono bliźniacze próbki o takiej samej powierzchni i taką samą powłoką w 3 warstwach. Porównano 3 różne odcienie powłok, oraz próbki referencyjne, bez warstwy wykańczającej. Zbadano również wpływ wielkości ziarna przy szlifowaniu, stosując dwie różne wielkości przy pracach. Metoda Xenotest jest szybsza i wykazuje tylko niewielkie różnice w strukturze zmian w porównaniu do metody zewnętrznej, ale tylko w przypadku farb pigmentowych. Przy powłokach transparentnych różnice wyników metod rosły, natomiast jakość powierzchni miała bardzo istotny wpływ na zmiany koloru w przypadku testu Xenotest. W celach szybkiej oceny systemów lakierniczych można stosować Xenotest, natomiast dokładne określenie zmian koloru wymaga metody zewnętrznej.

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