

Weathering test of furfurylated wood decks in a 3-year exposure in Greece

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Furfurylation is a modification process commercially carried out in order to improve biological resistance and water-repellence of wood (Lande et al. 2004, Westin and Alfredsen 2007, Lande et al. 2008). In terms of weathering performance, Temiz et al. (2007) reported that furfurylated wood (FF) showed only slightly higher resistance to accelerated weathering than untreated wood. For the purposes of this work, a 3-year outdoor weathering test of furfurylated wood decks was carried out. The following wood materials were used: (i) a deck of furfurylated Radiata pine (*Pinus radiata*) wood, (ii) a deck of furfurylated Maple (*Acer spp.*) wood, both delivered to Greece by Kebony AS (Skien, Norway), and (iii) a deck of Ipê (*Handroanthus spp.*) wood that was used for comparative reasons as control deck. All decks had surface dimensions of 80 x 120 cm and thickness of ca. 22 mm and were exposed outdoors without any protection or finishing.

Furfurylation treatment was carried out by Kebony AS applying a commercially implemented process based on a full cell (vacuum/pressure) impregnation with a aqueous polymerisable mixture of furfuryl alcohol, buffering agents, maleic anhydride and other catalysts (Larsson-Breid 2013) followed by an intermediate vacuum drying step before steam curing and drying (post curing). The decks were exposed outdoors for 36 months in Karditsa, Greece, in order to evaluate physical and structural properties such as colour, staining, distortions, surface cracking and end-splitting. Colour changes were determined according to CIELAB colour system using a BYK Gardner tristimulus colourimeter. Twelve colour measurements were carried out for each deck. Evaluation of staining was made macroscopically. Each deck was carefully examined for staining and other discolourations. The distortions in wood decks were measured with a dial gauge adjusted on a custom-made reference guide. All properties were determined prior to weathering and also after 6, 12, 24 and 36 months. Cracking and splitting were assessed by taking and analysing photos of all surfaces using a reference ruler for comparison purposes.

The conclusions drawn can be summarised as follows (Table 1; Figure 1 and 2): (a) all tested decks showed colour changes that were perceptible by naked eye and were relatively much higher during the first twelve months and much lower during the following ones; (b) the furfurylated decks showed smaller colour changes compared to the control deck of Ipê wood; (c) concerning surface cracking, furfurylated Radiata pine wood generally showed minor surface cracks and furfurylated Maple wood deck presented the lowest degree of surface and edge cracking; (d) the wood decks tested along with the control Ipê wood deck have showed no macroscopic signs of black staining and no decay after three years of outdoor exposure in Karditsa, Greece.

Table 1: Mean values of the determined colour coordinates and total colour changes of furfurylated and control wood deck throughout the 3-year weathering period

Property	Deck type	Months of weathering				
		0	6	12	24	36
Mean L^*	Ipê (control)	40.59	49.68	48.51	47.05	51.64
	FF Radiata pine	33.95	43.17	43.96	43.94	45.42
	FF Maple	39.54	49.18	41.31	43.55	47.04
Mean a^*	Ipê (control)	9.61	7.81	2.19	-1.15	1.71
	FF Radiata pine	9.01	6.76	2.01	1.39	2.27
	FF Maple	9.80	5.60	1.89	1.59	2.66
Mean b^*	Ipê (control)	16.47	12.98	7.20	8.03	6.50
	FF Radiata pine	15.23	11.63	7.52	6.96	8.88
	FF Maple	19.05	11.44	6.34	6.26	10.09
ΔE^*	Ipê (control)	---	10.53	15.41	16.43	17.69
	FF Radiata pine	---	10.99	14.89	15.46	15.19
	FF Maple	---	13.98	15.73	16.28	14.02



Figure 1: Furfurylated Radiata pine wood deck: (left) as in May 2011 and in May 2014 (right)



Figure 2: Furfurylated Maple wood deck: (left) as in May 2011 and in May 2014 (right)

References

- Lande S., Westin M., Schneider M. 2004. Eco-efficient wood protection: furfurylated wood as alternative to traditional wood preservation. *Management of Environmental Quality: An Inter. Jour.*, 15, 5: 529–540
- Lande S., Eikenes M., Westin M., Schneider M. 2008. Furfurylation of wood: chemistry, properties and commercialisation. *Development of Commercial Wood Preservatives*. ACS Symp. Series, 982: 337–355
- Larsson-Brelid P. 2013. Benchmarking and state of the art for modified wood. SP Report n. 54 (2013), SP Technical Research Institute of Sweden, Stockholm, Sweden, pp. 30.
- Westin M., Alfredsen G. 2007. Durability of modified wood in three different soil types (TMCs) In: *Proc. of the 3rd European Conference on Wood Modification*. Cardiff, United Kingdom, pp. 309–316
- Temiz A., Terziev N., Eikenes M., Hafren J. 2007. Effect of accelerated weathering on surface chemistry of modified wood. *Applied Surface Science*, 253: 5355–5362

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