Technical Service Request Report

Technical Service
CE BL COATINGS

Ciba

Customer:	**Titan Wood BV, Netherlands**	**Lab Report No:**	**12661**
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Performance evaluation of acetylated wood from Titan Wood Ltd.

Tested light stabilizers:	LIGNOSTAB® 1198; TINUVIN® 477DW; TINUVIN® 5100
Coating system:	WB acrylate
Substrate:	Radiata pine; Scotch pine; Accoya
Exposure:	Xe-WOM CAM 7, prEN927-6
Tested properties:	CIE-L*C*h and ΔE*; Gloss 60°, Cracking

1. Introduction

Acetylated (Accoya) wood from Titan Wood Ltd. based in the UK, (www.titanwood.com) is a highly durable wood for high performance application like window frames etc. In this study the performance of TINUVIN® 477 DW as well as the LIGNOSTAB® 1198 concept should be evaluated on acetylated and non-modified radiate pine. Due to the use of UV absorber as well as Lignin stabilizer a better long term performance in terms of color retention as well as mechanical properties is expected.

2. Target

- Artificial exposure of acetylated and non-modified radiate pine

3. Summary

As summary it can be stated that Accoya still needs to be protected by the use of a coating with sufficient UV-VIS light protection to avoid any damages due to radiation and water. Here the use of UVA, like TINUVIN® 477 DW and LIGNOSTAB® 1198 as lignin stabilizer can be recommended not only in terms of color retention but as well in terms of retaining mechanical properties.

4. Experimental

4.1. Chemicals and Materials

All wood panels (radiata pine, acetylated radiata pine (Accoya), scotch pine) have been

supplied by company Titan Wood Ltd. The evaluated light stabilizer compositions are summarized in table 1. The aqueous acrylic formulation used in this study is shown in table 2.

Tab. 1: Evaluated light stabilizer compositions in aqueous coatings

# [1]	Pre-treatment [2]	Top coat [3]
12661-x-y-1	-	-
12661-x-y-2	-	5 % TINUVIN® 477DW
12661-x-y-3	-	5 % TINUVIN® 477DW + 0.5 % TINUVIN® 5100
12661-x-y-4	1 % LIGNOSTAB® 1198	5 % TINUVIN® 477DW + 0.5 % TINUVIN® 5100

1) Internal serial
x = 1: Xe-WOM CAM 7; x = 2: prEN927-6; x = 3: Pfeffingen, CH
y = 1: radiata pine; y = 2: Accoya; y = 3: scotch pine
2) % in deionised water
3) % on total paint

Tab. 2: WB acrylic formulation used in this study

Joncryl® 8383		85.00
EFKA® 2526		0.40
Deionised water		1.50
Dowanol PnP		7.50
GLASWAX® E1		3.60
RHEOVIS® PU10		1.50
EFKA® 3580		0.50
	Σ	100.00

4.2. Application and Methods

- **Application**

Substrate: Radiata pine (modified, untreated); Scotch pine (untreated)
Application: Brush
Impregnates: 1 x 80 - 100 g/m^2
Lacquers: 2 x 130 - 150 g/m^2

- **Color measurements**

Measured with Minolta CM-3600d (gloss included) and calculation of L*, a*, b*, C*, h and ΔE* with CGREC software according DIN 6174

- **Gloss readings**

Gloss evaluation at 60° with Byk/Gardner Micro-Tri-Gloss according DIN 67530

- **Cracking evaluation**

Cracking evaluation is performed visually according DIN EN ISO 4628-4

- **Accelerated weathering Xe-WOM CAM 7 (DIN EN ISO 11341 A)**

Machine type: Atlas Weather-O-meter Ci-65 A (two-tier rack)
Light source: 6.5kW Xenon burner water-cooled
Filter combination: Outer filter Boro S / Inner filter Boro S
Procedure: A

Cycle conditions:

102 min		Light
	0.35 W/m² @ 340 nm	Irradiance, controlled
	(60±2) °C	Black panel temperature
	(50±5) %	Rel. humidity at the end of the dry period
18 min		Light and Spray
	0.35 W/m² @ 340 nm	Irradiance, controlled
	(35±2) °C	Black panel temperature
	(95±5) %	Rel. humidity

- **Fluorescent UV light exposure for wood (prEN927-6)**

Machine type:		Q-Lab QUV
Panels size:		300x75x10mm
24 h		Condensation
	(45±3) °C	Black panel temperature
48 x 2.5 h		UV light
	0.77 W/m²	Irradiance
	(60±3) °C	Black panel temperature
0.5 h		Dark and spray
	(22±3) °C	Black panel temperature
Total cycle time = 168 h		=7 days

5. Results

5.1. Color deviation

The color deviation of radiata and scotch pine after 500 h Xe-WOM CAM 7 and 336 h prEN927-

6 exposure is shown in figure 1.The color deviation of radiata pine with and Accoya during Xe-WOM CAM 7 exposure is shown in figure 2. The coloristic data of radiata pine and Accoya after 500 h Xe-WOM CAM 7 exposure are shown in figure 3. The color deviation of Accoya after 500 h Xe-WOM CAM 7 and 336 h UV-A-340 is shown in figure 4.

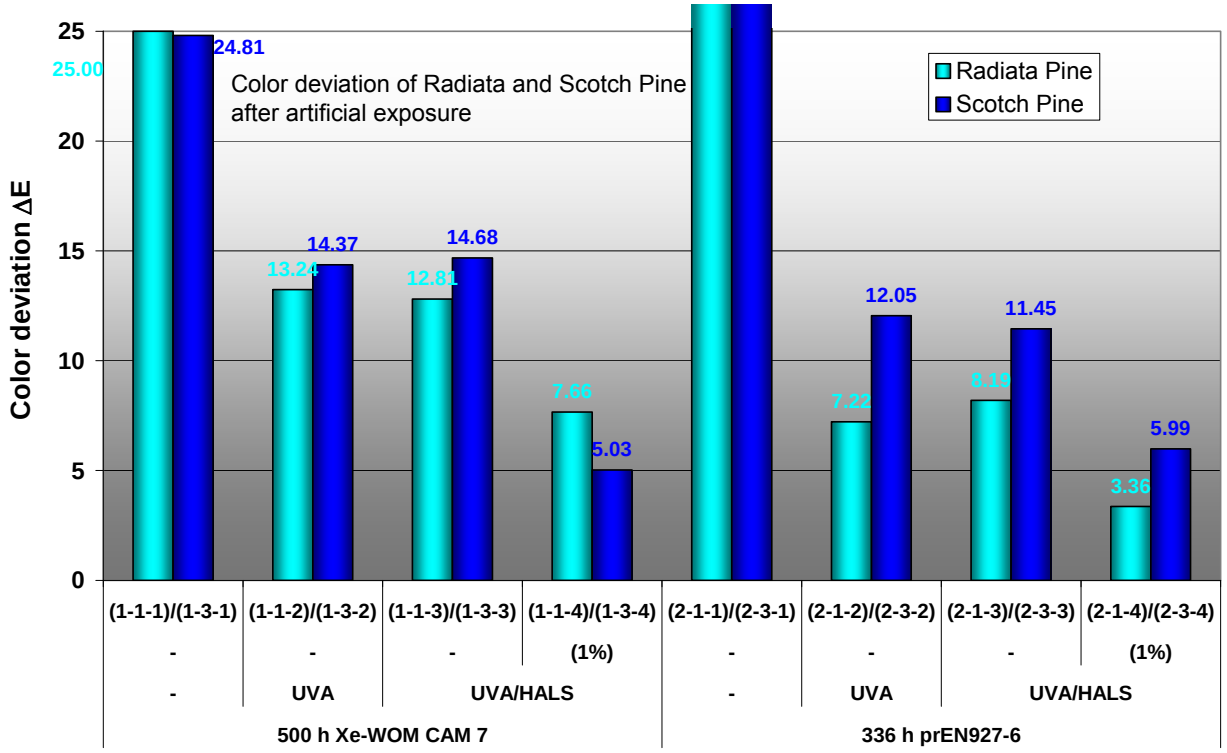

Fig. 1 Color deviation of radiate and scotch pine after 500 h Xe-WOM CAM 7 and 336 h prEN927-6 exposure

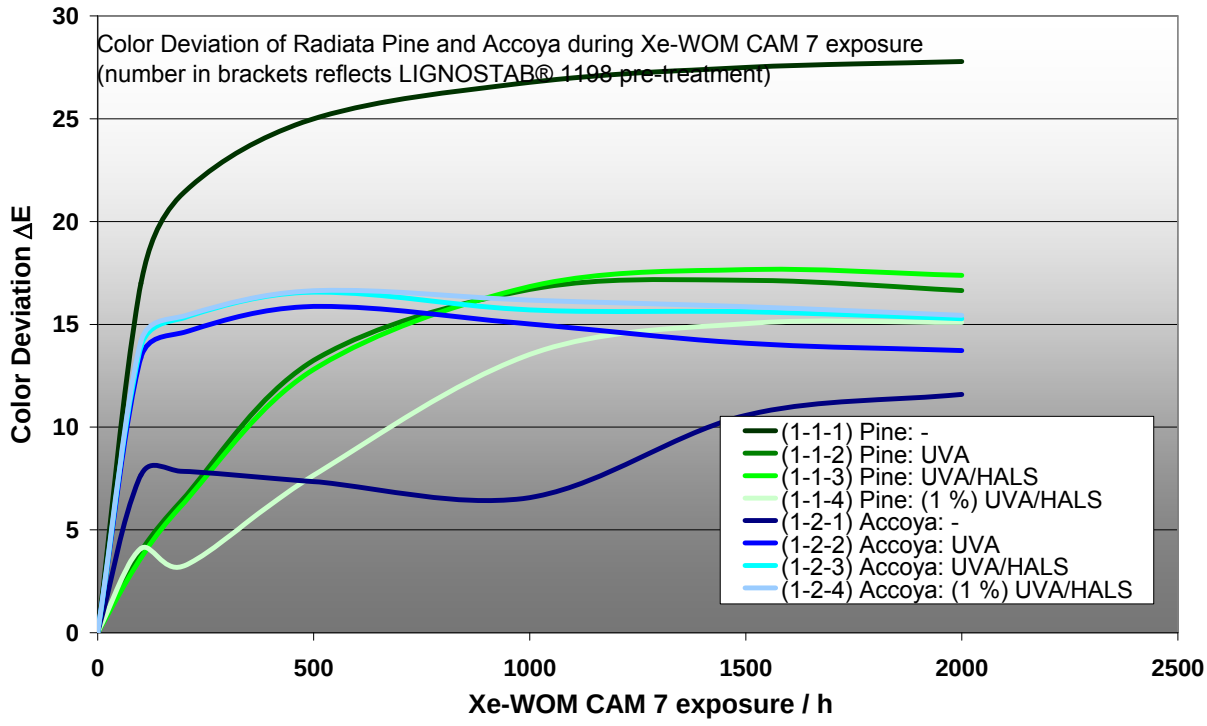

Fig. 2 Color deviation of radiata pine with and Accoya during Xe-WOM CAM 7 exposure

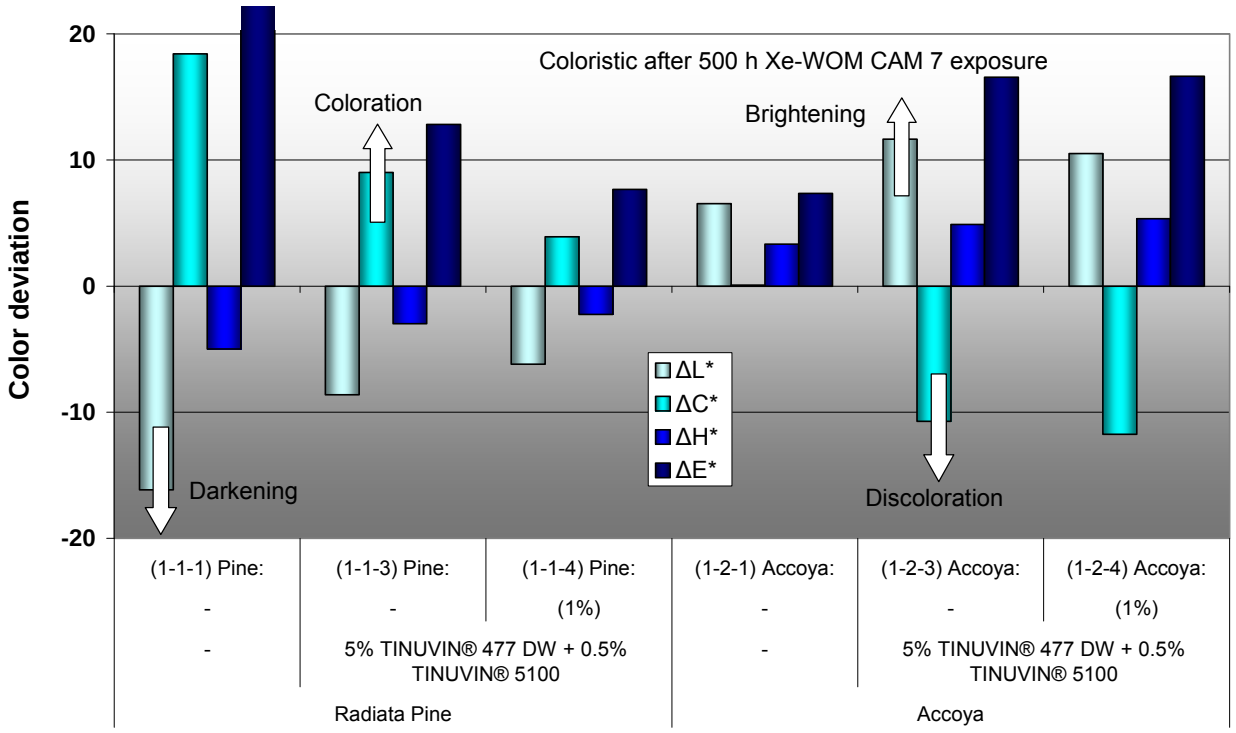

Fig. 3 Coloristic data of radiate pine with and without acetylation after 500 h Xe-WOM CAM 7 exposure

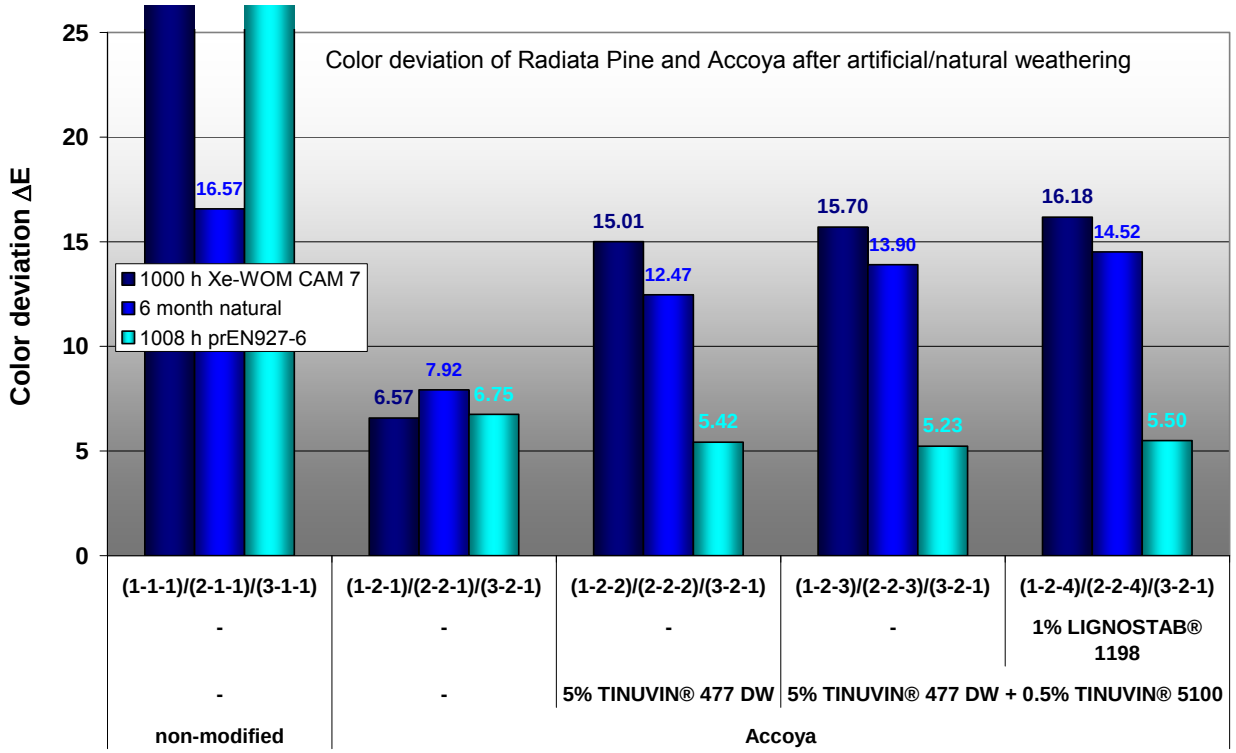

Fig. 4 Color deviation of acetylated radiate pine after Xe-WOM CAM 7 and prEN927-6 exposure

5.2. Pictures

The pictures of radiata pine and Accoya after 2000 h Xe-WOM CAM 7 are shown in figure 5.

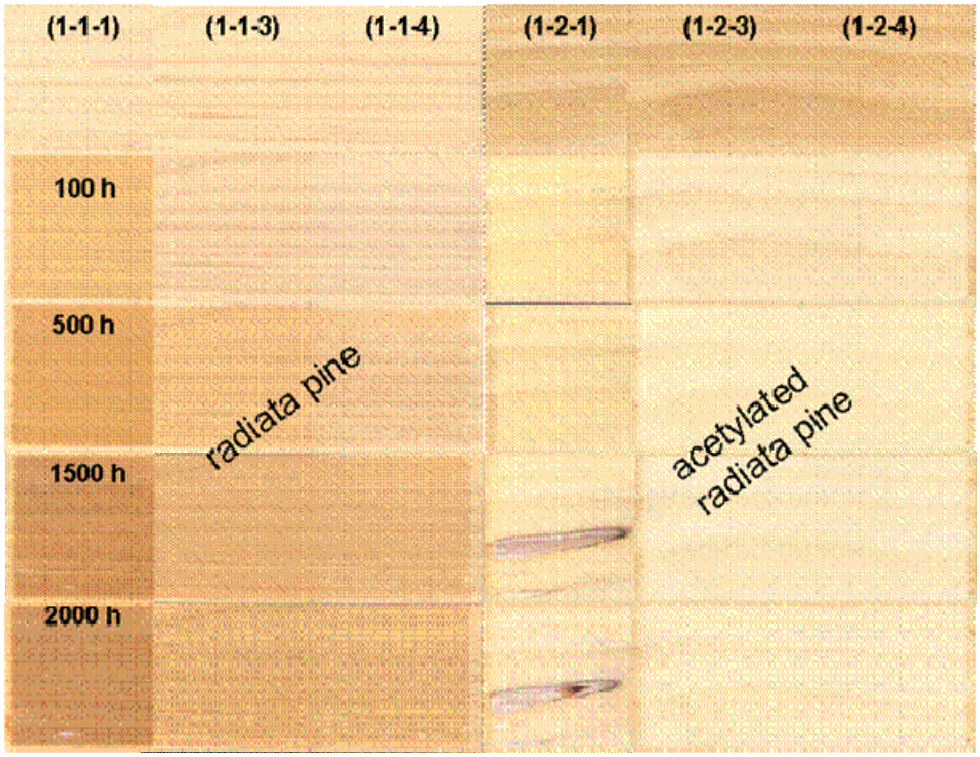

Fig. 5 Pictures of radiata pine and Accoya after 2000 h Xe-WOM CAM 7 exposure

6. Conclusions

Based on the results of the artificial weathering it could be stated that radiata pine and scotch pine behaves similar. A strong increase in ΔE can be seen without additives. ΔE can be significantly reduced by using UVA; here the use of HALS does not influence the color retention, i.e. HALS are protecting the paint film itself against surface defects like e.g. cracking. By far best performance is obtained by using the LIGNOSTAB® 1198 concept (s. fig. 1).

The comparison of ΔE in fig. 2 shows obvious different behavior of Accoya against non-modified pine. Here in general the use of UVA leads to a higher ΔE compared to the non-stabilized pine. This increase in ΔE is explained in fig. 3. Whereas for the non-modified pine the use of UVA and LIGNOSTAB® 1198 concept reduces the darkening and coloration, brightening and discoloration effects can be seen for the Accoya. These discoloration/brightening ("bleaching") effects are mainly induced by visible light what can be seen in figure 4. These effects appear only under Xenon exposure conditions and not under UV-A light exposure. An explanation for this brightening can be found in fig. 5 where it is shown clearly that acetylated pine shows obviously darker color compared to non-modified pine. So the bleaching effects are caused by minor visible light sensitivity of chromophores which has been built during the acetylation process. Nevertheless yellowing of the non-stabilized Accoya can be seen after Xenon exposure which can be explained by lignin degradation starting from carbonylic structures, i.e. hydroxylic structures are blocked via acetylation. (see Pathways of Lignin degradation, Phenacyl way)

As summary it can be stated that Accoya still needs to be protected by the use of a coating with sufficient UV-VIS light protection to avoid any damages due to radiation and water. Here the use of UVA, like TINUVIN® 477 DW and LIGNOSTAB® 1198 as lignin stabilizer can be recommended not only in terms of color retention but as well in terms of retaining mechanical

properties.

A more detailed schematic illustration about proposed color deviation mechanism is shown in the customer presentation given the 10.08.2006. The presentation, pictures and analytical data (CIE-Lab) during exposure can be found on the delivered CD