



Title: Lamination of Accoya™ wood with Dynea Prefere 6151 / 6651 for non-load bearing applications

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Summary

Titan Wood B.V. appointed SHR Timber Research to investigate the ability of laminating Accoya™ wood with Dynea Prefere 6151 (adhesive) / 6651 (hardener) according to BRL 2339. The technology behind Accoya™ wood is based on wood acetylation. In this investigation Accoya™ wood is tested as part of the research scheme for KOMO certification BRL 0605 “Modified Timber”.

Based on the test results it can be concluded that Accoya™ laminated with Dynea Prefere 6151 / 6651 (glued according to the specifications of the glue manufacturer) fulfils the requirements as described in part 2A of the (current) BRL 2339.

The additional tests that were performed according to the (most likely) future BRL 2339, show that there was no (structural) delamination in the laminated Accoya™ after the accelerated weathering and boiling test. Based on these results it is concluded that laminated Accoya™ can be regarded as a durable application in window frames.



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1 Assignment

Titan Wood B.V. appointed SHR Timber Research to investigate the ability of laminating Accoya™ wood with Dynea Prefere 6151 (adhesive) / 6651 (hardener). The technology behind Accoya™ wood is based on wood acetylation, a chemical modification process.

In co-operation with a Dutch certification body, SKH, and research institute SHR Timber Research, Titan Wood has established a research scheme to independently prove the quality of Accoya™ wood. This scheme consists of:

1. KOMO certificate BRL 0605 “Modified Timber”. Here the emphasis is on the uniformity and reproducibility of the production process, as well as on Titan Wood’s quality system.
2. Fulfilment of the (material) requirements as listed for in use of certified Dutch joinery (SKH Publication 97-04). Emphasis is on material properties, such as durability, dimensional stability and paintability.

In this research the lamination of Accoya™ wood with Dynea Prefere 6151 (adhesive) / 6651 (hardener) was studied according to:

- The current BRL 2339 (part 2a); the resistance against delamination according to the accelerated weathering test.
- The resistance against delamination according to the accelerated weathering test as mentioned in the BRL 1704-2 (this test will most likely be incorporated into the future BRL 2339)
- The resistance against delamination according to the boiling test (this test will most likely be incorporated into the future BRL 2339)

2 Execution of the test

2.1 Identification and description of the samples

Accoya™ wood samples (original wood species Radiata Pine) were taken from batch LG 175 produced in Titan Wood's pilot plant, originating from 4 different boards (board number RP 3, 6, 19 and 28). The adhesive Prefere 6151, the hardener Prefere 6651, and the product information sheets were delivered by Dynea.

2.2 Period of the test

The test was carried out from 24 October 2006 to 29 January 2007.

2.3 Procedure

2.3.1 Production of the samples

The Accoya™ wood samples were conditioned (to a constant mass) in a climate of $65 \pm 5\%$ RH and $20 \pm 2^\circ\text{C}$. Lamels of approximately 30 x 90 x 500 mm (thickness x width x length) were produced by sawing and planing. Immediately after sanding 3 lamels were glued together according to the instructions (product information sheets) provided by the glue manufacturer; application of 100 g/m^2 adhesive (Prefere 6151 with 15% hardener Prefere 6651) on both sides of a lamel (two sided glueing) and using a glue spreader. In total 4 samples were produced (each with 3 lamels) in the open time as specified in the product information sheet. Successively the samples were pressed for 2 hours at 20°C under a pressure of 0.6 N/mm^2 . After pressing the samples were conditioned in a climate room at $65 \pm 5\%$ R.H. and a temperature of $20 \pm 2^\circ\text{C}$ for a period of 28 days.

After conditioning, the samples were used to prepare the test specimens as described within the different tests:

- Accelerated weathering according to the current BRL 2339;
- Accelerated weathering according to the future BRL 2339;
- Boil test according to the future BRL 2339.

2.3.2 Accelerated weathering according to the current BRL 2339

Preparation of the test specimens

The test specimens were prepared by cutting the glued samples. The test pieces had a length of 90 mm along the direction of the grain. The test pieces were made to be as smooth as possible in order to improve the evaluation of any possible delamination.

Accelerated weathering of the test specimens

The test specimens were subjected to accelerated weathering according to the following 1-week-cycle for 3 weeks:

- 8 hours of IR-radiating with a maximum surface temperature of 70 °C
- 24 hours sprinkling with water of 15 °C
- 40 hours freezing at a temperature of -10 °C
- 8 hours sprinkling with water of 15 °C
- 16 hours resting (no actions)
- 8 hours of IR-radiating with a maximum surface temperature of 70 °C
- 64 hours resting (no actions)

Evaluation of the test specimens

After the accelerating weathering the test specimens were visually evaluated and the total length of the open glue joints was measured (with an accuracy of 1 mm) using a precision magnifying glass.

2.3.3 Accelerated weathering according to the future BRL 2339

Preparation of the test specimens

The test specimens were prepared by cutting the glued samples. The test specimens had a length of 200 mm along the direction of the grain. Before testing, both cross sections of the samples were sealed twice with an epoxy resin. After that the complete test specimens were coated twice with a dark coloured coating (acrylic dispersion, colour RAL 7016) to a total dry paint layer thickness of 80 µm.

Accelerated weathering of the test specimens

After storing the test specimens for 7 days at $23 \pm 2^\circ\text{C}$ and $50 \pm 5\%$ R.H., the specimens were subjected to accelerated weathering according to the following schedule for a duration of 3 weeks:

- 8 hours sprinkling with water of $15 \pm 2^\circ\text{C}$;
- 8 hours of IR-radiating with a surface temperature of $75 \pm 5^\circ\text{C}$.

Evaluation of the test specimens

After the accelerated weathering, the test specimens were visually evaluated with regard to the appearance of cracks in the coating layer and/or delamination.

2.3.4 Boiling test according to the future BRL 2339

Preparation of the test specimens

The test specimens were prepared by cutting the glued samples. The test specimens had a length of 50 mm along the direction of the grain. The test specimens were made to be as smooth as possible in order to improve the evaluation of any possible delamination.

Weathering of the test specimens

After weighing the test specimens, they were put in a waterbath, leaving the crosscut ends free. Weights were placed on top of the test specimens in order to prevent them from floating. Subsequently the test specimens were weathered according to the following procedure:

- 4 hours boiling in water;
- 20 hours drying at $65 \pm 1^\circ\text{C}$;
- 4 hours boiling in water;
- 20 hours drying at $65 \pm 1^\circ\text{C}$.

Evaluation of the test specimens

After weathering the test specimens were visually evaluated and the total length of the open glue joints was measured (with an accuracy of 1 mm) on all faces.

2.4 Apparatus

- Woodworking machinery.
- Sandpaper grit 100.
- Glue spreader (Meister No. 422400).
- Balance with an accuracy of 0,1 gram (SHR number 023).
- Mechanical glue press (Instron).
- Waterbath (SHR number 334).
- Climatized rooms; $65 \pm 5\%$ R.H. / $20 \pm 2^\circ\text{C}$ and 50 ± 5 RH / $23 \pm 2^\circ\text{C}$.
- Precision magnifying glass.
- Feeler gauge 0,1 mm.
- Accelerated weathering chambers.

3 Results and discussion

3.1 Accelerated weathering according to the current BRL 2339

In table 1 the results of the current BRL 2339 are shown. It can be concluded that the glued samples of Accoya™ fulfil the requirements of the current BRL 2339; maximum 10% of the glue joint may be open, measured on the crosscut ends, and averaged for all samples.

Table 1. Results of the accelerated weathering test according to the current BRL 2339.

| Test specimen | Weight specimen | | Total length of glue joint [mm] | Total length of open glue joint [mm] | Percentage of open glue joint [%] |
|----------------|--------------------------|-------------------------|------------------------------------|---|--------------------------------------|
| | before weathering [g] | after weathering [g] | | | |
| 6349-1 | 355 | 379 | 359 | 0 | 0.0 |
| 6349-2 | 385 | 414 | 360 | 0 | 0.0 |
| 6349-3 | 388 | 418 | 360 | 0 | 0.0 |
| 6349-4.1 | 404 | 435 | 360 | 0 | 0.0 |
| 6349-4.2 | 406 | 437 | 360 | 0 | 0.0 |
| Average | | | | | 0.0 |

3.2 Accelerated weathering according to the future BRL 2339

In table 2 the results of the accelerated weathering test according to the future BRL 2339 are shown. Because the future BRL 2339 is still under development, there are no official requirements for this test at this moment.

Table 2. Results of the accelerated weathering test according to the future BRL 2339.

| Test specimen | Weight specimen | | Total length of glue joint [mm] | Total length of open glue joint [mm] | Percentage of open glue joint [%] |
|----------------|--------------------------|-------------------------|------------------------------------|---|--------------------------------------|
| | before weathering [g] | after weathering [g] | | | |
| 6349-1 | 790 | 795 | 1000 | 0 | 0.0 |
| 6349-2 | 886 | 897 | 1001 | 0 | 0.0 |
| 6349-3 | 901 | 907 | 1002 | 0 | 0.0 |
| 6349-4 | 921 | 930 | 1001 | 0 | 0.0 |
| Average | | | | | 0.0 |

3.3 Boiling test according to the future BRL 2339

In table 3 the results of the boiling test according to the future BRL 2339 are shown. Because the future BRL 2339 is still under development, there are no official requirements for this test at this moment.

Table 3. Results of the boiling test according to the future BRL 2339.

| Test specimen | Weight specimen | | Total length of glue joint [mm] | Total length of open glue joint [mm] | Percentage of open glue joint [%] |
|----------------|--------------------------|-------------------------|------------------------------------|---|--------------------------------------|
| | before weathering [g] | after weathering [g] | | | |
| 6349-1.1 | 194 | 188 | 557 | 0 | 0.0 |
| 6349-1.2 | 197 | 191 | 557 | 0 | 0.0 |
| 6349-2 | 214 | 207 | 558 | 0 | 0.0 |
| 6349-3 | 218 | 211 | 558 | 1 | 0.2 |
| 6349-4 | 226 | 220 | 558 | 0 | 0.0 |
| Average | | | | | 0.0 |

4 Conclusion

Based on the test results it can be concluded that Accoya™ laminated with Dynea Prefere 6151 / 6651 (glued according to the specifications of the glue manufacturer) fulfils the requirements as described in part 2A of the (current) BRL 2339.

The additional tests that were performed according to the (most likely) future BRL 2339, show that there was no (structural) delamination in the laminated Accoya™ after the accelerated weathering and boiling test. Based on these results it is concluded that laminated Accoya™ can be regarded as a durable application in window frames.

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