Specialty Wood Products Research Partnership

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Thermal Modification of Douglas fir for Improved Durability

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FOREST GROWERS RESEARCH

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EXECUTIVE SUMMARY

Douglas fir has been thermally modified at two temperatures; 220°C and 230°C (each for 2 hours).

These modifications are expected to improve the durability of the sapwood, while maintaining the durability of the heartwood. Fungus cellar (durability) testing of the modified wood is underway. Sufficient material has been thermally modified to allow future graveyard durability testing, if sufficiently good results are seen in the fungus cellar.

INTRODUCTION

Thermal modification involves heating wood to high temperatures in the absence of oxygen to improve the wood properties such as dimensional stability and durability. A wide range of wood species are currently thermally modified on a commercial scale. Previous work at Scion found thermal modification of Douglas fir increased the durability of both the heartwood and the sapwood, but as this was a preliminary screening test the extent of this durability improvement is unknown. Here Douglas fir heartwood and sapwood were modified with two schedules expected to give improved durability (220° and 230°C), and the durability of the heartwood and sapwood evaluated separately in fungus cellar stakelet tests. The fungus cellar testing will give an indication of the level of durability improvement in the Douglas fir. If these results are promising, further graveyard durability tests will start in the 2019/20 financial year. These longer term tests will show if the modified wood reaches H3.1 or H3.2 levels, and data from these will be required if the modified Douglas fir was to be commercialised for H3.1 or H3.2 applications.

METHODS

Existing Douglas fir framing timber from Scion was used for this work (dressed 90x45mm, predominantly heartwood, dried to ~12% MC).

The Douglas fir boards were sorted into heartwood boards (~50 lineal metres), and a heart-sap mix (~50 lineal metres). These 'parent' boards were cut into 600mm long boards, with small (30mm) biscuits cut from between each sample, and moisture content was determined on these. These were sorted into three charges with equal numbers of heartwood and sapwood boards in each. Where three or more short boards were cut from a single parent board, these were distributed between the charges, to enable end-matching of boards from each charge. Each charge had 70 boards, which is more material than should be required for the current planned testing, but ensures there will be plenty of suitable boards for downstream testing.

The charges were modified as follows:

1. Unmodified control charge
2. Modified at 220°C for 2 hours
3. Modified at 230°C for 2 hours

Following modification, fungus cellar stakelets were cut (150 x 10 x 5mm quarter-sawn) from the following treatments:

1. Heat modified at 220C using only heartwood of D-fir
3. Heat modified at 220C using sap/heart mix of D-fir
4. Heat modified at 230C using only heartwood of D-fir
6. Heat modified at 230C using sap/heart mix D-fir
7. Unmodified heartwood of D-fir
8. Unmodified sap/heart of D-fir
9. CCA treated wood for H3.2 specification (for comparison)
10. Heartwood of Red, Mountain or Hard beech (for comparison)

At least 20 stakelets were cut from each treatment, and prior to testing half the stakelets were leached according to Australasian Wood Preservation Committee (2015). Stakelets are tested in warm, moist soil beds (27°C, 85%RH) and their condition assessed every 3 months according to ASTM D1758 (2006). This test normally runs for three years, but interim results will be reported annually.

New fungus cellar tests can only be started during one of the scheduled three month assessments, to avoid disturbing existing experiments. Due to high demand for Scion's durability testing facilities, the fungus cellar stakelets were not able to be installed during the March assessment, so they were installed in early June 2018.

Samples for Decking and L-joint tests, and all other remaining material has been stored for testing at a later date.

RESULTS

Modification conditions

For the 220°C charge, all 70 boards were modified at once. This was the maximum capacity of the small thermal modification kiln, and the wood temperature struggled to get to 220°C, even with the kiln heated to 240°C (10°C lower than the maximum temperature cut-out). For the 230°C modification, two modification runs were done, each with 35 boards. With the smaller stack the wood temperature had no trouble reaching 230°C. Plots of the conditions in each charge are shown in Figures 1-3. Other than the increased heat up time for the 220°C charge, the charges all ran normally, and were typical of radiata pine thermal modification schedules used by Scion.

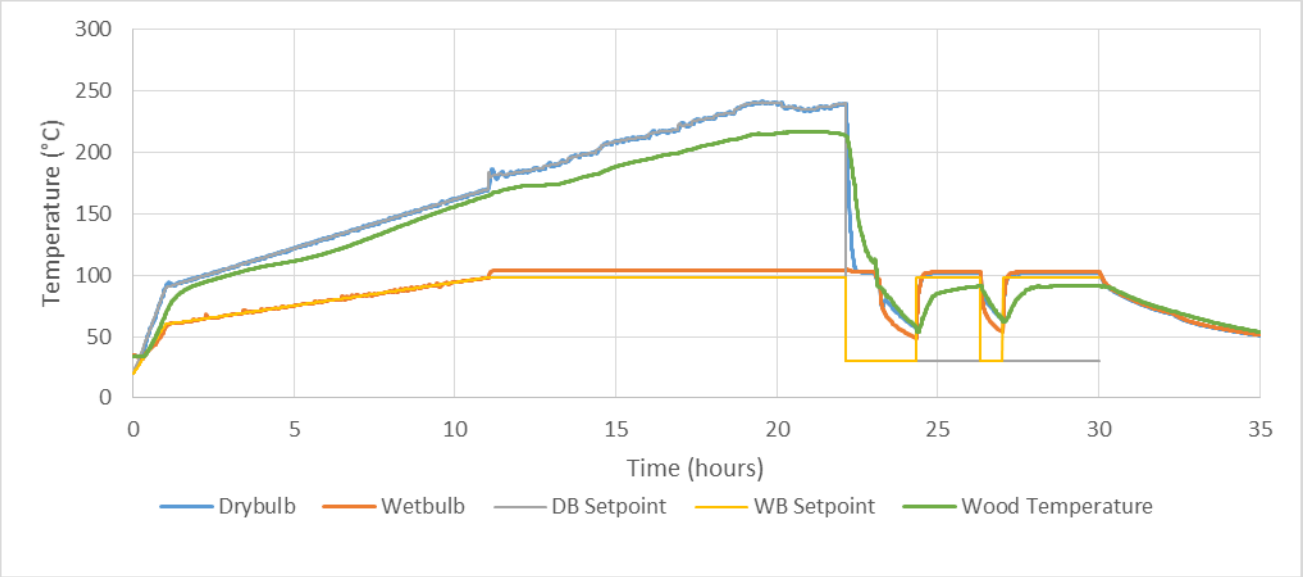

Figure 1. 220°C Modification

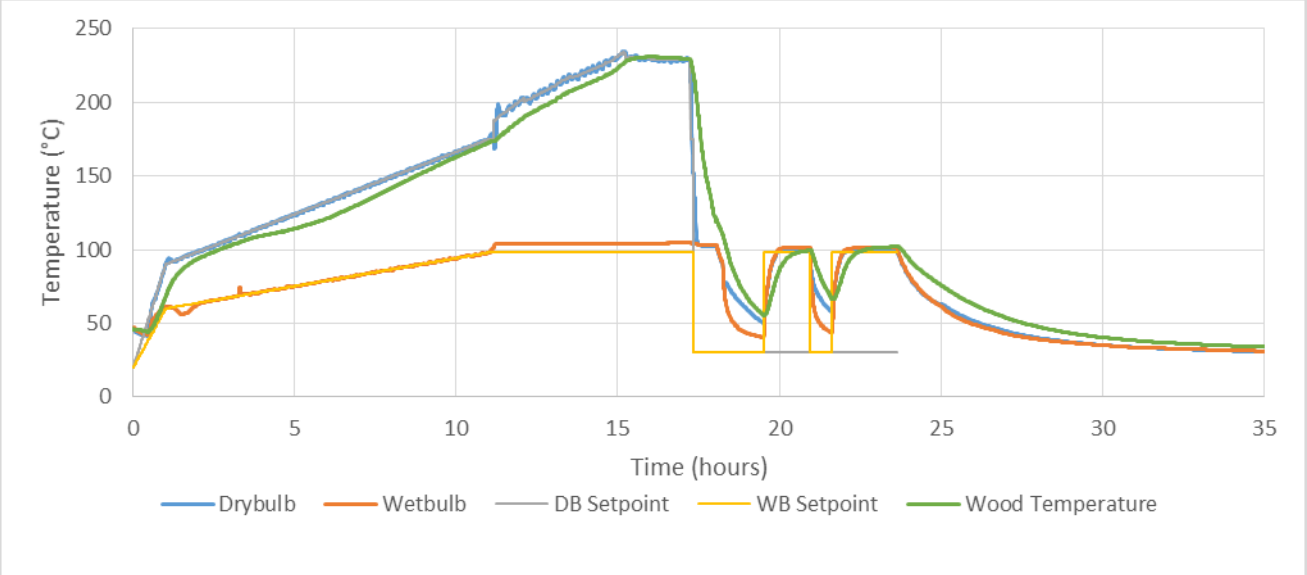

Figure 2. First 230°C Modification

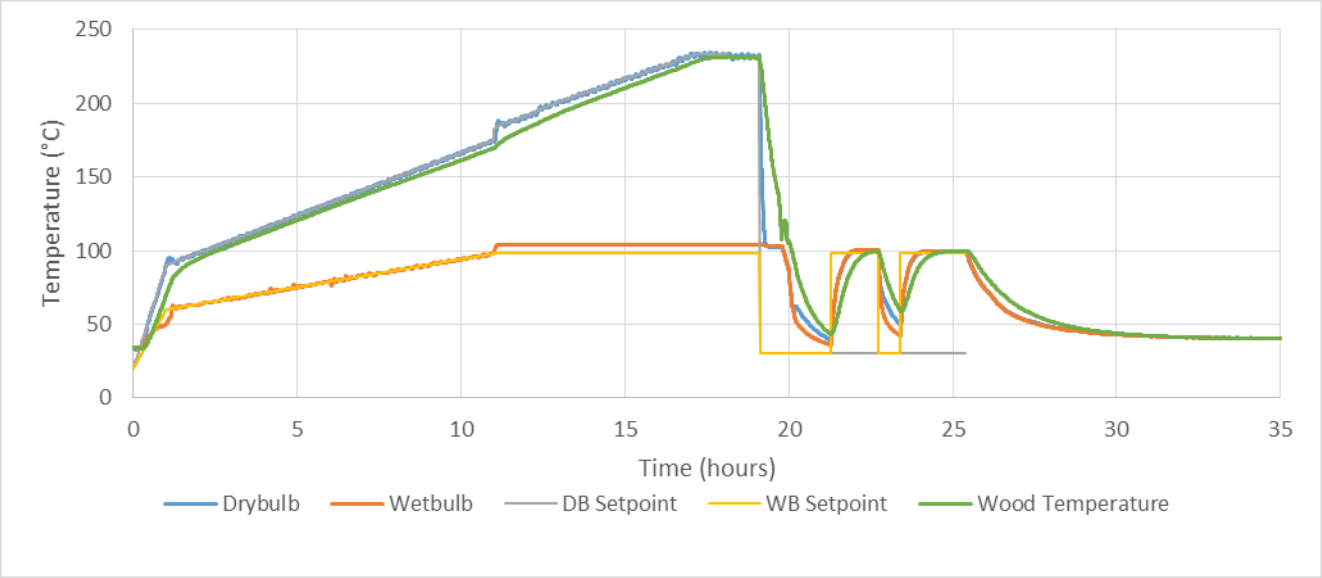

Figure 3. Second 230°C Modification.

CONCLUSION

The Douglas fir boards were successfully modified, and fungus cellar stakelets began testing in early June and will be assessed every three months.

ACKNOWLEDGEMENTS

Bruce Davy prepared all the Douglas fir boards for modification. Bruce and Jamie Agnew cut the fungus cellar stakelets. Jackie van der Waals is performing the fungus cellar testing.

REFERENCES

ASTM D1758. (2006). Standard Test Method of Evaluating Wood Preservatives by Field Tests with Stakes.

Australasian Wood Preservation Committee. (2015). *Protocols for assessment of wood preservatives.*