DRYING MIXED SAWN SIZE AT DIFFERENT INITIAL MOISTURE CONTENT IN A COMMERCIAL TIMBER DRYING KILN

Zahidah Zafhian,
Wood Drying Laboratory, Forest Product Division,
Forest Research Institute Malaysia, 52109, Kepong, Selangor
E-mail: zahidah@frim.gov.my

Sik Huei Shing
Wood Drying Laboratory, Forest Product Division,
Forest Research Institute Malaysia, 52109, Kepong, Selangor
E-mail: sik@frim.gov.my

Ho Wai Mun
Forestry Biotechnology Division,
Forest Research Institute Malaysia, 52109, Kepong, Selangor
E-mail: howaimun@frim.gov.my

How Seok Sean
Wood Lamination Laboratory, Forest Product Division,
Forest Research Institute Malaysia, 52109, Kepong, Selangor
E-mail: howss@frim.gov.my

Ramzul Iklas Ablah
Wood Drying Laboratory, Forest Product Division,
Forest Research Institute Malaysia, 52109, Kepong, Selangor
E-mail: ramzul@frim.gov.my

ABSTRACT

Generally, acacia timber species are prone to drying defects due to their inherent characteristics. The prolong processing time for acacia timber is associated directly to the drying issues of the timber. In previous studies, a dedicated drying regime has been established for this particular timber species, to ensure that proper treatment can be applied to minimise the occurrence of various drying defects in an efficient manner. In most scenario, drying mixed sawn timber with different moisture content in a single kiln charge is inevitable in actual commercial processing activities, due to current demand and also subject to availability of raw materials. This study evaluates the drying performance of acacia sawn of significant moisture content variations from freshly sawn and partially dried acacia timber of mixed sawn size, based on a commercial kiln drying trial. The commercial drying trial, using an existing lumber kiln was conducted in a timber processing mill in Kota Kinabalu, Sabah. The drying study to assess the drying performance of approximately 40-ton of acacia sawn consist of 2 width measurements, i.e. 50mm and 75mm respectively of various lengths from 600mm up to 1500mm. The thickness of all sawn timber was fixed at 25mm thick with provision for shrinkage allowance. The initial moisture content of all sawn size was determined using standard oven drying method. Initial moisture content of 25mm x 50mm (thick x width) acacia sawn timber of partially dry condition, ranged from 12.56 to 48.74%. Whereas, initial moisture content of 25mm x 75mm acacia sawn of green to partially dried condition, ranged from 50.22 to 157.30%. During drying, the moisture content of selected sample boards from the two different group of conditions were recorded at a regular interval. Overall, drying time for 25mm x 50mm sawn timber of partially air-dried condition to reach 7-9% moisture content, was about 14 days. Drying time for 25mm x 75mm sawn timber of green to partially air-dried condition, was recorded at about 18 days when the timber reached the same moisture content as the smaller sawn size group. Both the different sawn size groups was discharged at the same time. The smaller sawn size group was left in the kiln for prolonged period so as not to disrupt on-going drying process for the much wetter timber 25mm x 75mm within the same kiln charge. The results of the drying trail showed that it is considered to be viable to dry mixed acacia sawn size of different initial moisture content in the same kiln charge. However, drying timber of different sawn size in terms of width or thickness will depend on the type of timber species. For efficient and quality drying of acacia timber, it is preferably to dry the timber of same sawn thickness and not more than 25mm in sawn width different in a the same kin charge.

Key words: sawn timber, moisture content, sawn dimension, drying

INTRODUCTION

Generally, acacia timber species are prone to drying defects due to their inherent characteristics. The timber is prone to warping, splitting or checking and lack of uniformity in the final moisture content when the wood is treated and dried. Due to the characteristics of acacia, drying acacia wood with consistent results using conventional methods is very challenging. Consequently, it caused prolonged processing time for acacia timber, extended kiln resident time, slow turnaround time and reduced drying energy efficiency as the timber must be dried relatively slowly in order to minimise the above-mentioned defects. In previous studies, a dedicated drying regime has been established for this particular timber species, to ensure that proper treatment can be applied to minimise the occurrence of various drying defects in an efficient manner (Sik et al. 2018).

In most scenario, drying mixed sawn timber with relatively distinct moisture content variations in a single kiln charge is inevitable in actual commercial processing activities, which is heavily depends on the availability of raw materials and also subject to seasonal market demand. Furthermore, the inherent high initial MC in acacia timber has rendered additional challenges to the drying of the timber with distinctively varied ranges of MC often found in individual board with presence of random moisture pockets along the length, as well as between boards of different batch-conditions.

Generally, it is common to find acacia timber with high initial moisture content (MC) of more than 100%, and extremely high MC exceeding 200% has also been reported in acacia wood. Under tree stands, moisture contents of the stems of *A. mangium* and hybrid Acacia were extremely high both in the sapwood and heartwood of the timber, and highest MC found in the inner heartwood was 253% for both A. *mangium* and hybrid Acacia, while in sapwood, the moisture contents were 149% and 154%, respectively (Yamamoto 2003). Besides, similar observation also reported in physical properties assessment of juvenile acacia trees. Tan (2014) reported that the mean initial moisture content of *A. mangium* sawn timber for 7-, 10- and 13-year-old material were 119%, 105% and 113% respectively.

Several practices to sorting timber before drying have been suggested over the years to avoid problems such as under-dry or over-drying, dimensional stability and low-grade recovery. It is found that pre-sorting timber based on moisture content can helps to improve drying time and timber recovery (Brian & Omar, 2016). Berberovic & Milota (2011) also determined that sorting based on initial moisture content should reduce drying time and greatly reduce final moisture content variability.

Generally, the timber processing mill rarely perform pre-sorting of timber before drying as to save time and minimise the energy consumption from conducting a multiple drying charge. Thus, the timber of mixed sawn with different initial moisture content and sizes was dried under the same kiln charge. The drying of mixed sawn in the same kiln charge is found to be feasible to be conducted, by practicing a good drying schedule and incorporation of equalizing and conditioning stages in the drying process (Gene, 1992).

This paper discussed the drying performance of acacia sawn of significant moisture content variations from freshly sawn and partially air-dried acacia timber of mixed sawn size under the same kiln charge using a commercial steam-heated drying system.

MATERIAL AND METHODS

The commercial drying trial was conducted in a timber processing mill in Kota Kinabalu, Sabah. This drying study assessed the drying performance of approximately 40-ton acacia sawn timber of 2-width measurements, i.e. 50mm and 75mm respectively of various lengths from 600mm up to 1800mm. The thickness of all sawn timber was fixed at 25mm thick with provision for shrinkage allowance.

Prior to drying, initial moisture content (MC) values of 80 pieces of randomly selected sample boards were determined (Figure 1). Based on the results of initial MC obtained from these sample boards, 4 pieces of control sample boards of 1800mm length from each width measurement group were selected for periodical monitoring of drying performance study.

The acacia sawn timber was properly stacked in a box-shaped size with vertically aligned stickers at specific spacing before being loaded into the kiln for the commencement of the drying process (Figure 2). The selected 8 control sample boards with an extended sticker were placed beside the timber stacks at different height, and also in various locations in the kiln.

The optimised drying schedule used was a moisture content based recipe with the initial dry bulb temperature (DBT) limited to 50°C or lower and final DBT to be maintained below 70°C (Sik et al. 2018). During drying, the moisture content of selected control sample boards from the two different group of conditions were recorded at a regular interval. Moisture content (MC) data during drying were estimated by periodically weighing the selected sample boards. The kiln charge was dried to a targeted approximately 6-8% MC based on estimated oven-dried weight.

After drying, the final MC of acacia sample boards were determined and the estimated current moisture content of the sample boards were normalised accordingly. The respective drying curves of both acacia sawn widths was plotted based on set drying time interval(s).

Figure 1. Labelling of sample boards and selected control sample boards prior to drying.

Figure 2. Stacking of timber with properly aligned stickers at specific spacing.

RESULTS AND DISCUSSION

Initial Moisture Content

The initial moisture content (MC) of all sample boards of the 2-width groups with various sawn lengths from 600mm up to 1800mm, was determined using standard oven drying method (Figure 3). Results showed that the initial MC of 25mm x 50mm (thickness x width) acacia sawn timber of partially-dried condition, ranged from 12.56 to 48.74%. Whereas, initial MC of 25mm x 75mm acacia sawn of green to partially air-dried condition, ranged from 50.22 to 157.30%.

Figure 3. MC determination based on standard oven drying method.

Drying time of mixed sawn acacia at different initial moisture content

For drying performance study, 4 control sample boards were selected from each of the 2 different sawn width groups respectively. The drying behaviour of acacia sawn from these two sawn groups was illustrated in Figure 4. and Figure 5. respectively. The initial moisture content (MC) of 25mm x 50mm (thickness x width) acacia control sample boards of partially air-dried condition, ranged from 20.23 to 35.86%. Whereas, initial MC of 25mm x 75mm acacia control sample boards of green to partially dried condition, ranged from 65.82 to 141.20%. The selection criteria for control sample boards was based on the median MC range group which consisted 80% of the total sample boards.

Overall, drying time was about 14 days for 25mm x 50mm sawn timber of partially air-dried condition to reach 6-8% moisture content. Drying time for 25mm x 75mm sawn timber of green to partially air-dried condition, was recorded at about 18 days when the timber reached the same targeted moisture content range as the smaller sawn size group (Figure 5). The different sawn size groups was discharged from the kiln at the same time. The smaller sawn size group was slightly over dried of about 2% (Figure 4) as this sawn group was only discharged after an extended kiln period, so as not to disrupt the on-going drying process for the much wetter timber of 25mm x 75mm within the same kiln charge.

Figure 4. Drying behaviour of A. mangium sawn samples (25mm x 50mm) at different initial MC (%).

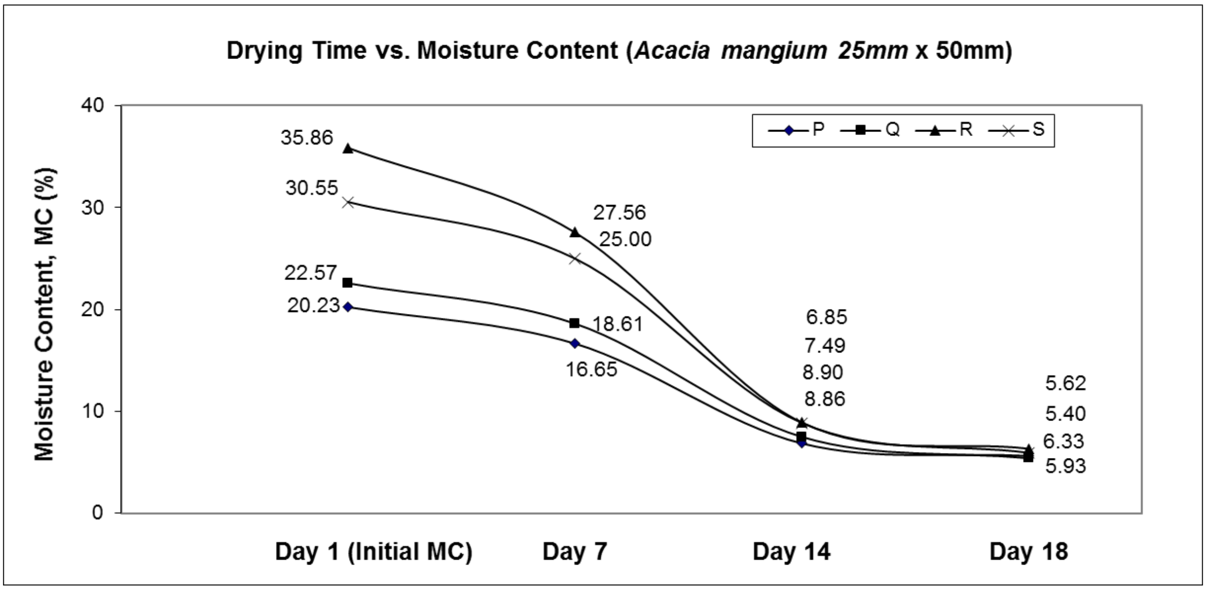
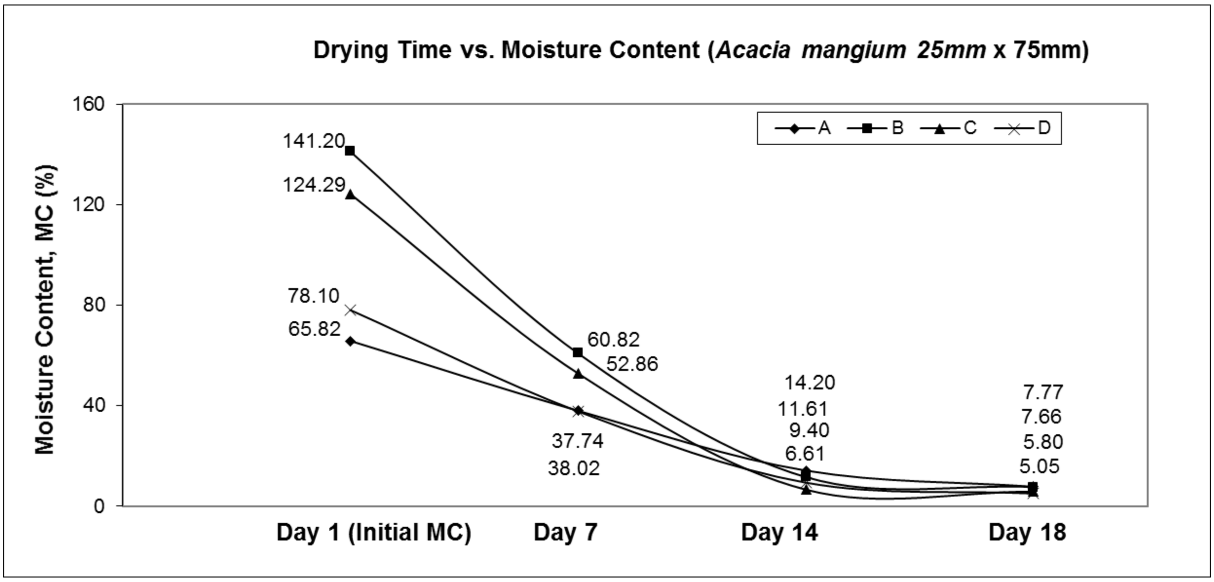


Figure 5. Drying behaviour of A. mangium sawn samples (25mm x 75mm) at different initial MC (%).



Dried acacia samples were sliced into shell and core sections across the transverse face to determine the distribution of moisture content within the individual sample. The moisture content (MC) profiles of selected acacia control sample boards during drying are shown in Figure 6. and Figure 7. respectively.

The mixed sawn acacia samples were able to dry uniformly throughout the timber and the variation of MC between the inner and outer layers were within 1.5% after the conditioning treatment, which was carried out before the end of drying. This showed that the drying-cum-treatment regime employed in this study was able to dry the mixed sawn timber of significant initial MC variations with effective moisture movement from the core towards the surface during drying. This study was also supported by Gene (1992) that by adopting a good drying regime, it is viable to dry timber of different sizes and initial moisture content in the same kiln charge, and the MC variation can also be reduced within permissible range.

It is common to find that when improper or harsh drying regime employed on timber species prone to drying defects including acacia timber, a discontinuous course of moisture movement from the core to the surface will render the timber more susceptible to the occurrence of casehardening effect. Therefore, it is important to have a balanced control of moisture evaporation from the wood surface as well as the movement of moisture from the core towards the surface to prevent severe drying which can cause defects such as surface cracks and end splits. Besides, severe casehardening can lead to serious internal checks such as 'honeycombing' effect in the timber which affect the structural integrity of the timber.

Figure 6. Moisture content profiles of individual A. mangium sawn samples (25mm x 50mm) during drying.

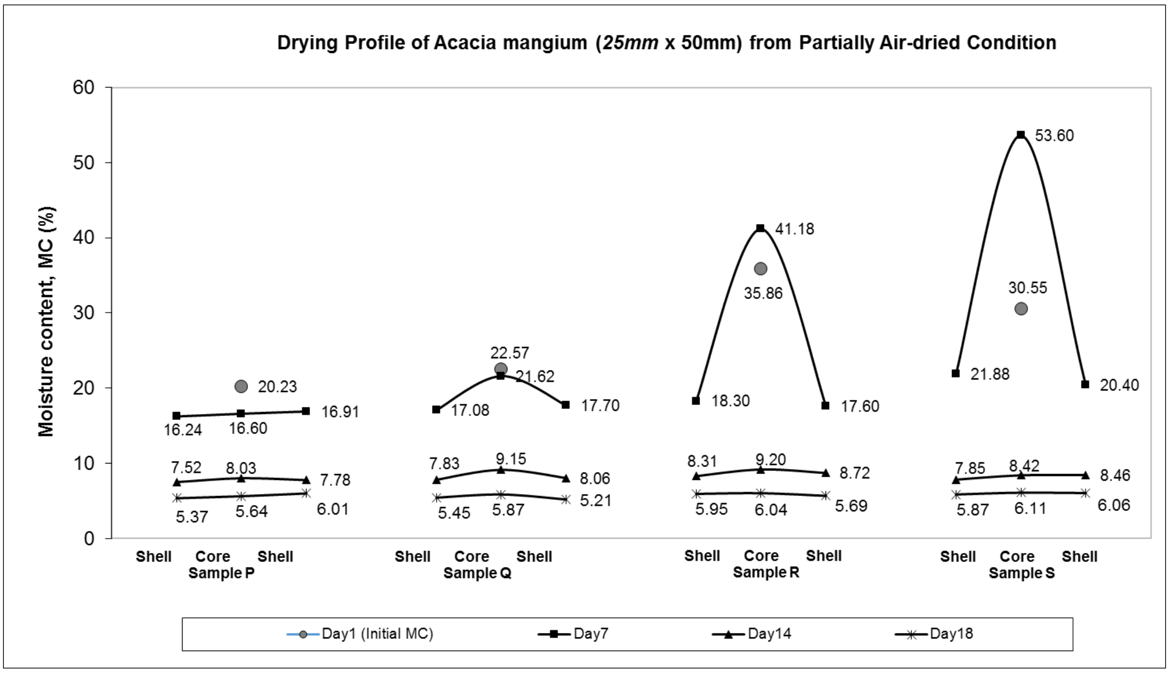
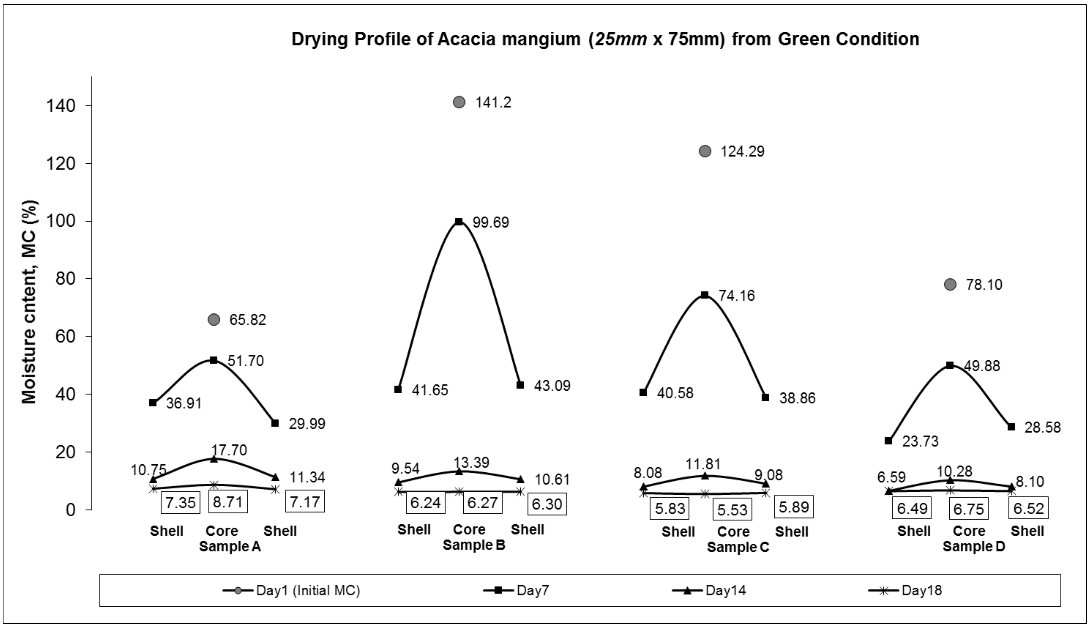


Figure 7. Moisture content profiles of individual A. mangium sawn samples (25mm x 75mm) during drying



CONCLUSIONS

The results of the drying trial showed that it is considered to be viable to dry mixed acacia sawn size of different initial moisture content in the same kiln charge. However, drying timber of different sawn size in terms of width or thickness will depend on the type of timber species. For efficient and quality drying of acacia timber under the same kin charge, it is highly recommended to dry this timber species of the same sawn thickness and not more than 25mm in sawn width difference.

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