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SAWING SCHEME OF OIL PALM TRUNK FOR REDUCED SAWN-LUMBER DISTORTIONS ON DRYING

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The physical and mechanical properties of oil palm trunk (OPT) are far from homogeneous (Kamarudin *et al.*, 2011). The conversion of OPT to sawn-lumber has to be carried out immediately, as long-term storage may not be economical. This is to prevent insect and fungal attacks due to high moisture and starch contents (Nur Syuhada *et al.*, 2011).

The OPT rarely exceeds 500 mm in diameter when delivered to sawmills. Therefore the most common sawing operation is the live-sawing (through-and-through) technique (Anis *et al.*, 2007). This method does not require any turning of the OPT, nor special skill in making the cutting decision. It is the fastest conversion method compared to other widely used sawing patterns such as sawing-around, cant-sawing and quarter-sawing (Todoroki and Ronnqvist, 2002).

However, the disadvantage of live-sawing technique is that the oil palm lumber (OPL) tends to contain a mixture of higher-density woody material in the outer edges together with a lower-density juvenile woody material in the middle piece (Anis *et al.*, 2007). The juvenile woody material region may be defined as a zone developing around the pith continuing towards the outer perimeter where its characteristics and properties are subject to gradual changes (Zobel, 1998). After drying, the gross sawing yield is highly reduced due to the development of seasoning defects. The main defects are collapse, warping and checks (splits) between vascular bundles and parenchymatous tissues (Koh *et al.*, 2009).

To mitigate this, the Malaysian Palm Oil Board (MPOB) has developed a sawing scheme to cater for these OPT characteristics and processing options. This would produce a lower rate of dimensional shrinkage during seasoning.

PROCESS DESCRIPTION

The OPT was cut across the diameter into sawn-lumber scantlings based on four types of sawing pattern, namely: (a) sawing pattern type A (SP-A), lumber scantling of 50 mm wide in radial and 50 mm thick in tangential planes (*Figure 1a*); (b) sawing pattern type B (SP-B), lumber scantling of 100 mm wide in radial and 50 mm thick in tangential planes (*Figure 1b*); (c) sawing pattern type C (SP-C), lumber scantling of 50 mm wide in radial and 100 mm thick in tangential planes (*Figure 1c*), and (d) sawing pattern type D (SP-D), lumber scantling of 100 mm wide in radial and 100 mm thick in tangential planes (*Figure 1d*).

After drying, shrinkages of OPL in radial, tangential and its cross-sectional area (volumetric shrinkage) were computed using Simpson's rule of numeral integration (Jordan and Smith, 1994):

$$_a\int^b y(x)dx = \frac{h}{3}(y_o + 4y_1 + 2y_2 + 4y_3 + ... + 4y_{N-1} + y_N) + \varepsilon_T$$

Truncation error: $\varepsilon_T \approx [-n(h)^5 f^{iv}(\xi)] + 180,\ a < \xi < b$

where N is an even number, $h = (b\text{-}a)/N$, y(x) is the integrand, h is segments of equal width, a and b are the limits of integration.

ADVANTAGES

The OPL scantlings showed a gradual change in lumber dimensions on drying. With different sawing patterns, the shrinkage of lumber width and thickness were different, particularly at 3 m tree heights and above (*Figure 2*). The expected changes in dimensional shrinkage of OPL scantlings for each respective sawing pattern could be identified. It was then possible to use these lumber shrink profiles to calculate the value of dimensional shrinkages of interest.

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Of the four sawing patterns, volumetric shrinkage of OPL scantlings from the SP-D type was the lowest, followed by the SP-A type, while those OPL sawn using both the SP-B and SP-C types were highest (too distorted) (*Figure 3*). However, it was noted that over a given level of tree heights, the shrinkage of OPL scantlings from SP-A type is not much better (particularly at 5 m to 10 m of tree heights) than those of SP-B and SP-C types.

Apart from moisture gradients (Salin, 1996), the variability of basic density and vascular bundles within the OPL scantlings (Kamarudin *et al.*, 2011) contributed to collapse, particularly the lower-density of juvenile material in the pith zone. In general, volumetric shrinkage of OPL scantlings for respective sawing pattern types (in descending order) are as follows: SP-C ≈ SP-B > SP-A > SP-D. It is therefore possible to predict the quantity of usable OPL scantlings that would be available after seasoning. Based on values of volumetric shrinkage (*Figure 3*), the OPL scantlings sawn using the SP-D type gave the highest lumber yield after seasoning.

CONCLUSION

The quality and value of OPL is largely determined during the sawing process, of which sawing pattern is important. In general, the sawing pattern will affect the recovery yield, the grade of sawn-lumber and the sawmill productivity. It was noted that most of the defective sawn-lumber were those from the central zone (pith). For OPT, basic properties-related parameters that include moisture content, vascular bundles and basic density will highly influence the behaviour of lumber shrinkage during drying. Therefore, the higher-density woody material from the peripheral zone has to be separated from a lower-density juvenile woody material in the middle piece prior to drying. Drying of sawn-lumber from both peripheral and central zones together would greatly reduce the overall yield of sawn-lumber produced.

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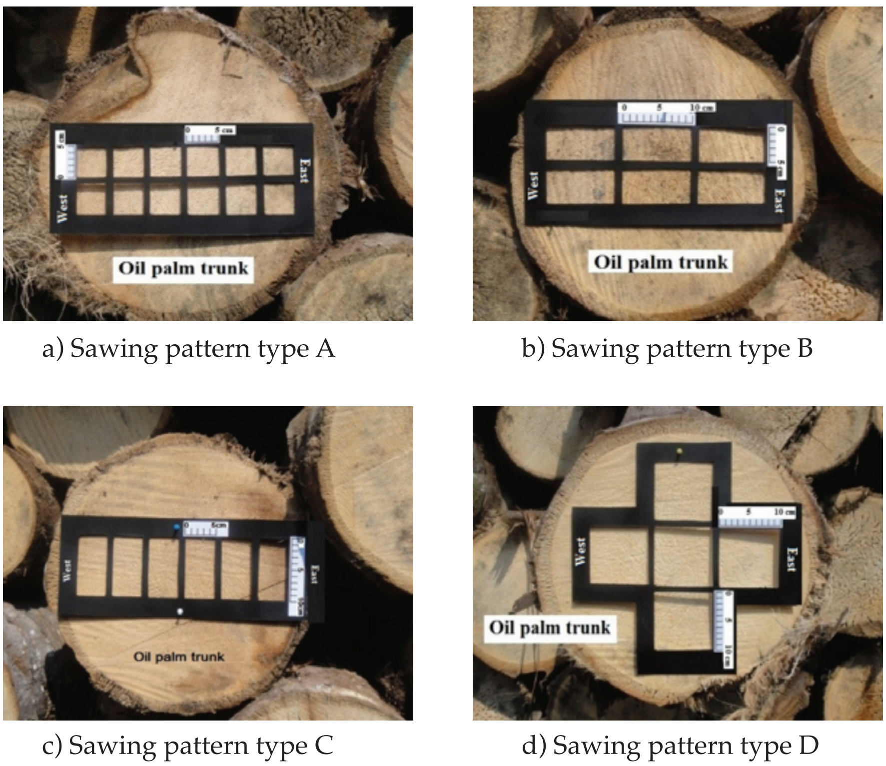
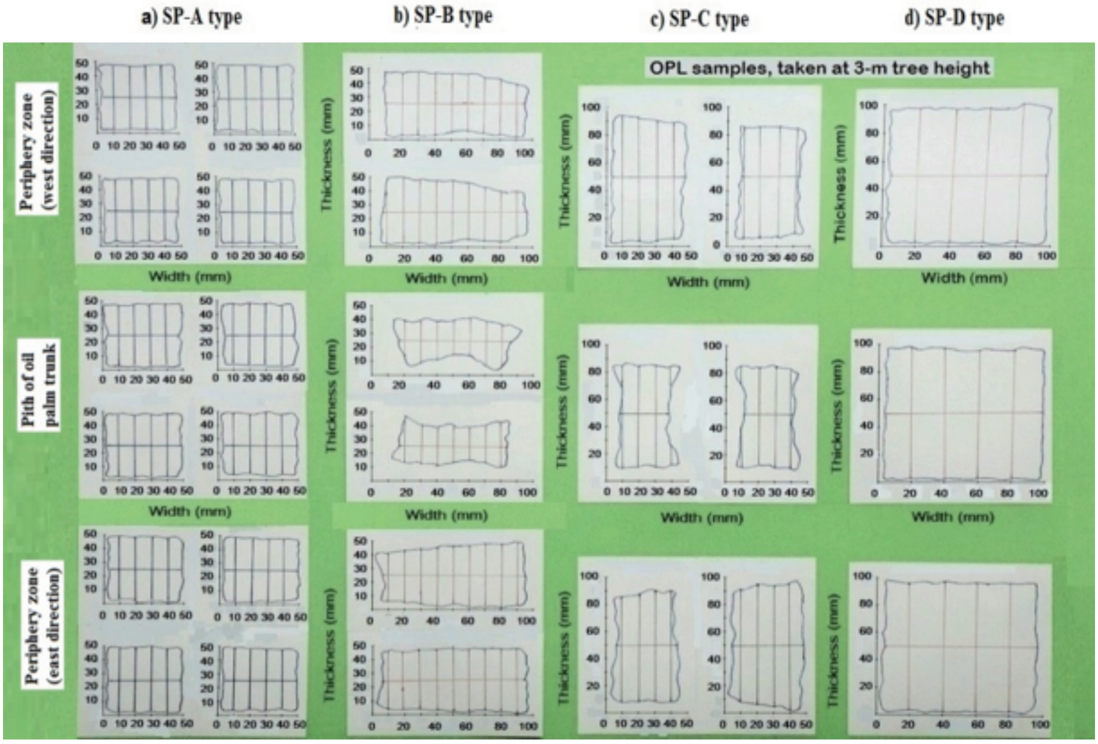


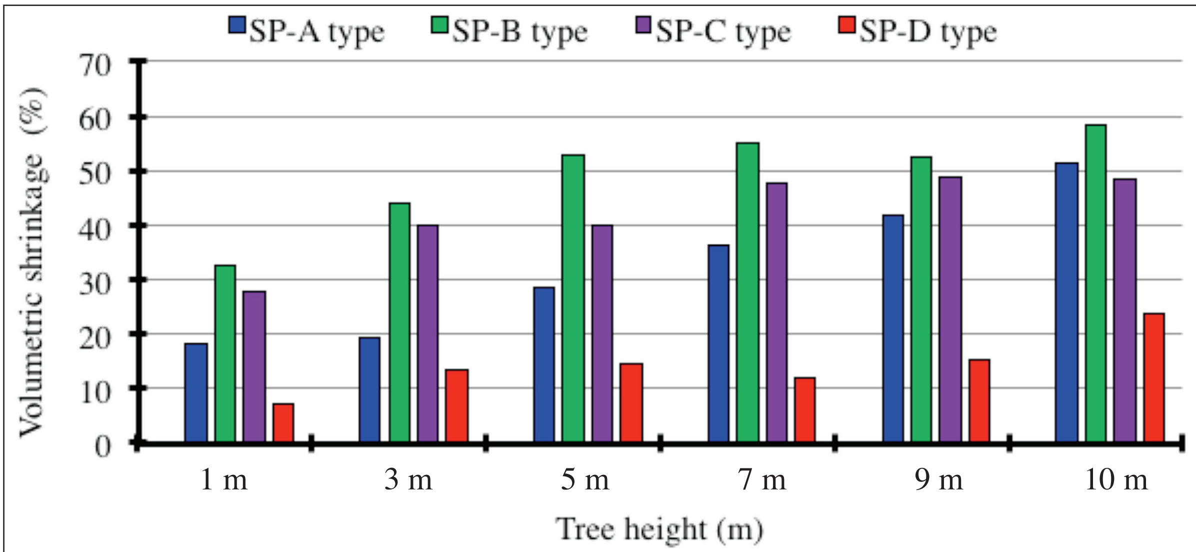
a) Sawing pattern type A
b) Sawing pattern type B
c) Sawing pattern type C
d) Sawing pattern type D

Figure 1. Positions of sawn-lumber cut from oil palm trunk based on different sawing patterns.



SP-A type is a lumber scantling of 50 mm wide in radial and 50 mm thick in tangential planes, SP-B type is a lumber scantling of 100 mm wide in radial and 50 mm thick in tangential planes, SP-C type is a lumber scantling of 50 mm wide in radial and 100 mm thick in tangential planes, and SP-D type is a lumber scantling of 100 mm wide in radial and 100 mm thick in tangential planes.

Figure 2. Typical dimensional shrinkages, in pith to periphery zone of oil palm lumber at 3 m tree height, based on different sawing patterns.



SP-A type is a lumber scantling of 50 mm wide in radial and 50 mm thick in tangential planes, SP-B type is a lumber scantling of 100 mm wide in radial and 50 mm thick in tangential planes, SP-C type is a lumber scantling of 50 mm wide in radial and 100 mm thick in tangential planes, and SP-D type is a lumber scantling of 100 mm wide in radial and 100 mm thick in tangential planes.

Figure 3. Mean volumetric shrinkage of oil palm lumber with tree heights, based on different sawing patterns.

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