Recovery of Oil Palm Lumber Production

Anis Mokhtar*, Noor Ainna Shamsudin, Ismail Sahid**, Halimah Muhamad***
and Astimar Abdul Aziz*

INTRODUCTION

The Malaysian timber industry has developed into a very significant socioeconomic sector, contributing 3.7% to the Growth Domestic Product (GDP) and 3.2% to the country's total merchandise exports in 2010. Indeed, the furniture business from the wood-based industry continues to expand due to the high demand from the worldwide market, particularly in the Asian region. This is evident from the total export of wooden furniture amounting to RM 6.7 billion in 2014, and by the fact that Malaysia is positioned as the ninth biggest furniture exporter in the world (Malaysian-German Chamber of Commerce, 2014).

Oil palm trunk lumber (OPTL) has been recognised as one of the potential raw materials to substitute rubber wood in the furniture business. Likewise, the cost of oil palm trunks is low as they are readily available after the palms are felled at 25 to 30 years of age based on their economic life span (Abdul Khalil *et al*., 2010; Anis *et al*., 2011).

As indicated by Mokhtar *et al*. (2008), replanting activities cover more than 70 000 ha of oil palm estates every year, obliging the felling of around 9 million palms in Malaysia. A few studies have been conducted to examine and enhance the physical and mechanical properties of Oil Palm Trunk (OPT), for example, its strength (Abdul Hamid *et al*., 2005; Rokiah *et al*., 2009) for the generation of value-added products. Aside from these, several researchers (Ul Haq *et al*., 2010; Abdul Khalil *et al*., 2012; Abdullah *et al.,* 2012) are similarly working to change this OPT biomass waste into an optional substitute wood lumber material. Such work results in positive effects, particularly in decreasing fossil fuel utilisation (by using biomass as an energy source) and also reducing the pressure of relying too much on tropical timber from the forests (Abdul Khalil *et al.,* 2010).

In order to maintain competitiveness in the wood-based market, maximising the volume recovery from logs is the principal need to enhance the transformation effectiveness and intensity in lumber production (Rappold *et al.,* 2007). Many aspects such as log diameter and sawing pattern can affect the resultant volume recovery, and this has been deliberated upon in past studies (Steele, 1984; Young *et al.,* 2007; Lin *et al.,* 2011).

However, there are just a couple of investigations on OPTL recovery because OPT is generally known to have unique properties which are different from other timber species, particularly in terms of moisture content (MC) and density properties. Those physical properties (MC and density) of lumber affect the criteria for selection of sawing pattern and volume recovery. Henceforth, this article provides data on OPTL

* Malaysian Palm Oil Board (MPOB)
6, Persiaran Institusi, Bandar Baru Bangi,
43000 Kajang, Selangor, Malaysia.
E-mail: anis@mpob.gov.my

** School of Environmental and Natural Resources Science,
Faculty of Science and Technology,
Universiti Kebangsaan Malaysia,
Selangor, Malaysia.

volume recovery for every phase of production, and hopefully this can give a clear idea on how to apply 'green' sustainability practices in the oil palm biomass sector.

MATERIALS AND METHODS

Log samples of oil palm trunks (*Elaies guineensis)* were harvested from 30-year-old palms (age for replanting) in a plantation in Kluang, Johor, Malaysia**.** To calculate the volume of each log before sawing, measurements of length, large-end, small-end and mid-diameter of each log were recorded. The live sawing pattern of the band saw (*Figure 1*) was used to cut the logs into lumber of 4 mm thickness. After sawing, the fresh lumber of each log was measured (length, width and thickness) and the volume (V) was determined using the formula below (Lin *et al.*, 2011):

$$V = W \times L \times T$$

where: V = volume of lumber recovered, W = width of lumber, L = length of lumber, and T = thickness of lumber.

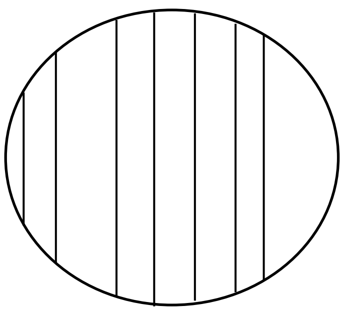

Figure 1. Live sawing.

Figure 2. Fresh lumber in a kiln-dryer.

Drying stage

After sawing, the lumber were stacked up to a height of 1.2 m using wood stickers inserted in a kiln-dryer (*Figure 2*). The stacked lumber were kiln-dried at a temperature following the schedule (*Table 1*) recommended by the Malaysian Timber Industry Board (2015). After the drying process, the lumbers were conditioned at room temperature for two days. The recovery of lumber (without defects) was then calculated.

Lumber recovery (LR), as a percentage, was determined by using the formula (Kukugho *et al.*, 2011) below:

$$LR\ \% = \frac{\text{Volume of lumber recovered } (m^3) \times 100}{\text{Volume of log } (m^3)}$$

RESULT AND DISCUSSION

Results indicate that the volume recovery of dried oil palm lumber was only 18.26% while the remaining 81.74% was considered as waste. The wastes which include lumber with defects, bark and sawdust can be used in other industries such as for the production of particle board, medium density fibreboard and other composites.

Complete drying time in this study was seven days, as the kiln-dry technique can reduce the drying period to 12 days (Balfas, 2006). The volume recovery within the drying period was just 28.49%, while the remaining 71.52% comprised defective lumber. These findings are in line with a study by Balfas (2006), who found that nearly 80% of defective oil palm lumber was produced after the drying process.

TABLE 1. KILN DRYING SCHEDULE FOR OIL PALM LUMBER

MC (%) of the wettest timber in the air inlet side	Dry bulb temperature (°C)	Wet bulb temperature (°C)	Approximate relative humidity (%)
Green	41	38	95
60	41	37	88
40	41	36	77
35	44	36	66
30	46	36	55
25	52	38	44
20	60	41	33
15	66	45	33

Source: Malaysian Timber Industry Board (2015).

TABLE 2. RECOVERY RATE PER M^3 OF OIL PALM LUMBER

Processing stage	Amount of wastage, % (based on volume)	Recovery rate, % (based on volume)
Storage yard (initial logs)		100
Sawing	35.87	64.13
Drying	71.52 (defects)	28.49
Total recovery from initial logs	81.74	18.26

The low volume of recovery resulted from the high temperature and low relative humidity during the drying process (Simpson, 1999). These conditions produced lumber with drying defects such as cupping, honeycombing and cracking as shown in *Figure 3*. A large portion of the deformed lumber came from the inner and upper parts of OPT, *i.e*. those parts having lower densities.

Cupping.

Honeycombing.

Cracking.
Figure 3. Lumber with defects.

CONCLUSION

The volume of lumber recovery is quite low due to the oil palm trunk characteristics which are high moisture content and variations in density. A mild schedule may be more suitable for drying to minimise such defects as collapse, checking, warping and excessive shrinkage.

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