Mechanical Properties of Polygon Oil Palm Lumber

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ABSTRACT

The oil palm (Elaeis guineensis) was first introduced to Malaysia in 1917 in Tennamaran Estate, Selangor as a commercial planting. It takes 3 years to mature before it bears fruit. The economic life of the oil palm extends to about 25 years, and after which, they have to be replanted. Huge quantities of biomass waste are generated from the oil palm industry in terms of trunks, fronds, empty fruit bunch and palm kernel. The wastes from these replanting activities are generally left to rot or burn in the field .These studies were observed by using Oil Palm Lumber (OPL) from different height levels (top, middle, bottom) and layers (L1, L2, L3). These OPL were cut using polygon method. Bending (MOE, MOR) and compression testing were applied to evaluate their mechanical properties. These mechanical properties of OPL can serve as an indicator for predicting the wood behavior for specific end usage. The findings revealed that there was no significant variation between the high levels for both testings. However, there is significant variation between layers for bending testing and no significance for compression testing.

Key words: *oil palm, polygon method, mechanical properties*

Introduction

The oil palm (Elaeis guineensis) was first introduced to Malaysia in 1917 on Tennamaran Estate, Selangor as a commercial planting. The tree takes 3 years to mature before it bears fruit. The economic life of the oil palm extends to about 25 years after which have to be replanted. Also, known as the "golden crop", the oil palm tree has positioned Malaysia as the leading nation in oil palm production (Killmann and Choon, 1985). In 2009, the crop covered 4.69 million ha of land, which is equal to 20% of total land area has been used for oil palm plantation (Anon, 2010). This comprise of land area of 32.85 million hectares, 13.15 million hectares in Peninsular Malaysia, 7.25 million hectares and 12.44 million hectares in Sabah and Sarawak FAO (2010). In line with the development of CPO production, the oil palm industry also produces in two forms 0f wastes, specifically waste from the mill and waste from plantation.

The waste from mill consist of shell, empty fruit bunch (EFB), pressed fruit fibres (PFF), palm oil mill effluent (POME), whilst the other wastes from the plantation comprises of oil palm fronds (OPF) and oil palm trunks (OPT). They increase up during replanting after reaching its economic life spans. Based on this situation, there is a great potential to utilize the oil palm waste such as oil palm trunk and oil palm fronds. As supported by the centre of Malaysian energy in 2008, as much as 2,110 million ton fronds and trunk are generated from CPO production. Oil palm trunk one of the potential residues materials for wood-based industry. The use of oil palm trunk and oil palm biomass for various products have been extensively explored , and some good results have been reported and produced a good result (Anis, 2006; Loh et al., 2010); Ratnasingam et al., 2008; Nasrin et al., 2008. Recently, oil palm trunk has emerged as a potential raw material for the manufacture of educational school furniture in the South East Asian region, on the basis of its acceptable strength and working properties (Ratnasingam and Joras 2009). In general, the main objective of oil palm lumber is to produce good quality products for the furniture industry. Thus, full utilization of the oil palm lumber from plantation or mill for furniture making would obviously be an advantage. The utilization of the oil palm lumber reduces the disposal costs and replaces solid wood. In furniture making the mechanical properties of oil palm such as bending and compression should be first identified. This can determine the standard or suitability of the material for furniture making. The specific objective of this study is to determine the physical properties (density), mechanical properties (bending and compression) and the effects of different height (top, middle and bottom) and layers (L1-near bark, L2-centre and L3 near pith) of oil palm lumber properties.

Material and Method

The material for the experiment was obtained from 24 years-old *Elaeis guineensis Jacq* from Jengka 25 Pahang, with a diameter ranges over 43cm - 55 cm. The trunk was divided to three portions 3 m (bottom), 3 m (middle), and 3m (top). The band-head rig (BS-6") was used to convert the trunk into lumber with polygon method and further process in a band-Resaw 4" to get the final of size 25 mm thick x 100 mm wide x 2000 mm long (Figure 1). The hot air drying method was used to dry the OPL until achieving the EMC, with is about approximately 12%-15% the moisture content. The process is shown in Figure 1.

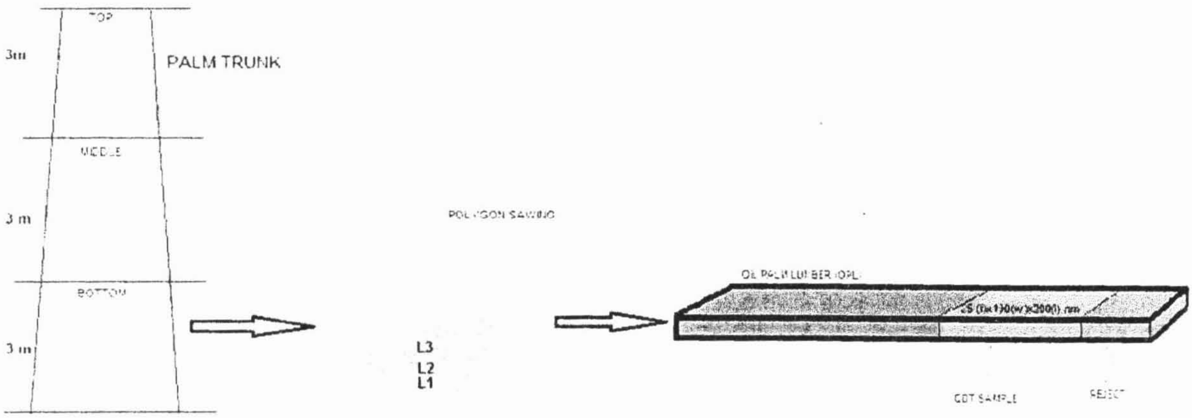

Figure 1: Flowchart Oil Palm Trunk Processing

The sample preparations were carried out according to the Technical Association of the Pulp and Paper Industries Standard (TAPPI, 1996) and the mechanical testing was followed according to BS 373: 195.

Findings and Discussion

Table 1: Statistical Analysis on ANOVA of the Effect of Portion and Layer of *Elaeis guineensis.Jacq* P<0.05

Sov	df	Density	MOR	MOE	Compression
Portion (P)	2	6.509^{**}	0.124^{ns}	0.421^{ns}	1.899^{ns}
Layer (L)	2	84.968^{**}	24.037^{**}	44.430^{**}	4.035^{ns}
P X L	4	4.216^{*}	2.327^{ns}	3.027^{ns}	3.834^{ns}

Note: ns-not significant p>0.05, * - significant at p<0.05, ** – highly significant at p<0.01

The average MOE values at various positions shown that those values are indicated a gradual decrease in MOE along the trunk height and depth. The MOE value range varies between 1228MPa and 1402MPa. Variation of the MOR also follows the same trend as the MOE. The mean values of MOR at peripheral, central and inner zones were about 14.62 MPa, 9.70 MPa and 6.03 MPa, respectively. Statistical analysis of density, MOR, MOE and compression show no significance at both variance accept for density, but the differences in trunk depth effect significantly at the level of 0.01 and the trunk height only influence significantly at the level of 0.05. It means that in order to produce the homogenous lumber, the trunk depth position should be taken into attention, especially in determining the sawing pattern before lumbering process. Bakar et al. (1999) investigate the mechanical properties of oil palm wood based on Tenera variety and the results show that all properties tested including MOE, MOR, compressive strength, cleavage strength, shear strength, hardness and toughness were decreased from the outer to the center and from the bottom to top of the trunk, where the influence of trunk depth factor was higher than the trunk height. Based on the mechanical properties, the most outer part of the oil palm trunk which is comparable to the Sengonwood (*Paraserianthes falcataria*) and belongs to the strength class III to V were considered to be used for light housing constructions and furniture (Sadikin, 1986, Takaya Namura, 2003). The results of these findings are due to the factors of anatomy and physical properties of oil palm lumber (Killmann and Choon, 1985, Lim and Khoo, 1986, Bakar et al., 1999, Paridah and Anis, 2008). The results also showed that the polygon method is suitable for sawing the OPL. This was mentioned by Bakar et al., (2006) where the polygon method can produce pure tangential lumber and produce the acceptable lumber recovery, sawing time and lumber quality.

Conclusion

The research study shows that the physical and mechanical of the oil palm wood is influenced by the position of OPL (outer to inner). It was also evident that the outer and middle region of the trunk is possible to produce lumber where the properties of boards produce closely similar in each layer.

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