Properties of Laminated Veneer Lumber From Oil Palm Trunk Veneer Using Different Adhesives

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Abstract

This study was undertaken is to determine the properties of laminated veneer lumber from oil palm trunk by using different adhesive and spread level. Experimental LVL panel from OPT veneers bonded with Polyvinyl acetate (PVAc) and Phenol Formaldehyde (PF) were produced with two adhesive spread levels; 180g/m^2 and 360g/m^2 for single glue line. Density, bending strength and tensile shear strength were then accessed based on BS 65666: Part 8:1985 standard. From the study it showed that, tensile shear strength was higher in panel bonded with PF with PVAC. The panels glued with PF using 360g/m^2 spread level showed better in MOR and MOE compare with other. Density of panel manufactured using PF using 180g/m^2 was higher compare with panel bonded with PF using 360g/m^2 and PVAc using 180 and 360g/m^2 spread level.

Keywords: *oil palm, laminated veneer lumber, veneer, PF, PVAc, spread level,*

INTRODUCTION

Prediction for the future indicates that the demand for timber by various wood-based industries in Asia and elsewhere will exceed the existing supply. Researchers in many parts of the world are focusing their effort in overcoming this anticipated shortage. Various alternative wood and non-wood forest products are being investigated for potential replacement to future timbers. One of these is the oil palm trunks.

Shortage of wood as a raw material has forced wood-based industries to find alternative local raw materials. Currently, oil palm biomass is ongoing research and development (R & D) and appears to be the most viable alternative. This work examines the conversion of OPT into new value added product and analyses its properties (Abdul Khalil, et.al ,2009). Laminated veneer lumber (LVL) is an engineered wood product manufactured from veneers that are rotary peeled, dried and laminated together with parallel oriented grains under heat and pressure with a waterproof adhesive. A higher strength product can be produced by this method from low-grade logs, due to the dispersion of defects from veneer to veneer (Ismail Aydin, 2005).

Research had found that oil palm trunk (OPT) can used in the making of LVL to produce various products including furniture and partition walls. LVL from OPT and the completed products by several manufactures in the country had already produce and uses in the Japanese marketing June 2004 (Abdul Hamid, 2006). It has the strength, durability and dimensional stability compared to normal solid oil palm. It provide the flexibility of shape and form, enabling designers and manufacturers to create furniture in varied shapes and form using the mould design (Mohamad Ariff et.al, 2007). OPT would be exploited commercially for various purposes such as particleboard, medium density fiberboard, plywood and LVL.

MATERIALS AND METHODS

The oil palm trunk veneers used in this investigation were supply by Forest Research Institute Malaysia (FRIM). The glue use in this study was supply by Malaysian Adhesive Company. Three LVL were produced from each of the different adhesive and glue spread level. Phenol formaldehyde and polyviniyl acetate with spread level 180 g/m^2 & 360 g/m^2 was used as the binding material to glue the veneers together. Three oil palm veneers were used to produce LVL of dimension 40 cm length x40 cm width x30 mm thickness.

The LVL were labeled and later cut into various sizes to accommodate the physical and mechanical tests. Prior to testing, all samples were conditioned in a condition chamber to attain moisture content (MC) of 12%. The samples were placed in the chamber which was set to 105±2°C for 24 hours. Testing of all samples was done in accordance with British Standard (BS) BS 6566: Part 8:1985. The physical tests focused mainly on the density, thickness swelling and the water absorption of the LVL. The strength tests for static bending and shear were conducted using the Instron Computer Controlled Universal Testing Machine located at the Universiti Teknologi Mara Pahang (UiTM).

RESULTS AND DISCUSSIONS

LVL Density

Table 1 shows the density of LVL different glue spreads of 180 g/m^2 and 360 g/m^2 using PF and PVAc. During experiment, it observed that different glue spreads of resin and the compression of the veneer during hot pressing affect the density of the LVL as seen in Table 1.The result showed that LVL manufactured using PF with glue spread 180 g/m^2 have higer densities than others. In contrast to the PF glued samples, the PVAc glued samples showed lower densities. In addition to the raw materials density, the adhesive properties of the resin also contribute to the density of the LVL as mentioned by Sulaiman et al., (2009)

Table 1: Density of LVL from oil palm trunk using PF and PVAc at 180 g/m^2 and 360 g/m^2 spread level

Adhesive	Sample	Density (g/cm^3)
PF	OPT 180 g/m^2	53.24 (2.81)*
	OPT 360 g/m^2	52.18 (3.15)
PVAc	OPT 180 g/m^2	36.46 (2.95)
	OPT 360 g/m^2	44.91 (0.18)

*Result in parenthesis indicate the standard deviation

Mechanical Properties

Table 2 showed the MOR, MOE and tensile shear strength of LVL from OPT at different spread level using PF and PVAc. Clearly, the results showed bending strength of LVL

using PF is higher than PVAc. For LVL made using a higher spred level (360 g/m^2), the bending strengths of the LVL were higher than those of LVL using a lower adhesive spread level (180 g/m^2), both for PF and PVAc resin. The higher spread level caused the adhesive that was spread on the surface of the oil palm trunk veneer to enter the pores, where it solidified and anchored.

Table 2: MOR, MOE and tensile shear strength of LVL from oil palm trunk using PF and PVAc at 180 g/m^2 and 360 g/m^2 spread level

Adhesive	Sample	MOR (MPa)	MOE (MPa)	Shear strength (MPa)
PF	OPT 180 g/m^2	32.43 (6.55)*	3978.96 (649.00)	2.35 (0.17)
	OPT 360 g/m^2	62.69 (18.45)	11187.34(2062.19)	2.71 (0.20)
PVAc	OPT 180 g/m^2	14.53 (2.66)	1852.58 (376.62)	0.69 (0.08)
	OPT 360 g/m^2	17.93 (1.167)	1854.93 (66.51)	2.01 (0.20)

*Result in parenthesis indicate the standard deviation

As shown in Table 2, LVL using PF possesses a higher bending modulus than LVL using PVAc. Higher values of bending modulus were found for panels made using PF compared to panels made using PVAc. This can be because of the fact that PF resin, when properly cured, often is tougher than the wood itself and results in a higher bending modulus as stated by Richard. The results showed that, as expected, the bending modulus was generally higher for the plywood using a higher glue spread level for both adhesives used. This behaviour can be explained by the better fibre-adhesive contact for plywood at a higher glue spread level.

The shear properties of oil palm trunk LVL were also studied. Table 2 shows the shear properties for samples with different glue spreads using PF and PVAc. It can clearly be seen that the bond strength of LVL panels increased when using a glue spread of 360 g/m^2; the lowest mean bond strengths were found in the OPT LVL using PF and PVAc with a glue spread of 180 g/m^2. Poor wettability is considered an indicator of poor bond durability. Wettability is recognised as an important criterion in evaluating evaluating the bondability of wood, and contact angle reflects the physical and chemical affinity between a wood surface and an adhesive. On the other hand, the rough surface of the oil palm trunk veneer was an obstruction to intimate contact between veneer surfaces and adhesive molecules. The glue resin used for bonding also plays an important role in the wettability of the plywood. From Table 2, it can be seen that LVL using PVAc has lower shear strength.

CONCLUSIONS

This studies on the use of the oil palm trunk as promising raw materials for laminated veneer lumber. The aim of this study, as mentioned above, was to determine the mechanical and physical properties oil palm trunk LVL. From research, it can be concluded that oil palm trunk improved some properties of LVL, such as bending strength and shear strength, especially for LVL using PF. LVL made using a 360 g/m^2 glue spread have better properties

than plywood made using 180 g/m^2 glue spread.In conclusion, oil palm trunk can be used to substitute raw materials to produce LVL, which will eventually increase the added value of these residues for use as interiors or exteriors. The oil palm LVL is catogerised in the light hardwood group and strength group C.

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