

**O**il palm trunk (OPT) is a naturally variable material, and thus, its physical and mechanical properties are far from homogeneous. For peeling of veneer, variations in basic properties-related parameters that include vascular bundles configuration, basic density distributions, moisture content gradients and shrinkage behaviour pose a challenge. Most oil palm veneers are affected, albeit to varying degrees, and this affects the integrity of palm plyboard produced from such veneers. Applications of plyboard such as concrete formworks, joinery and furniture require tough building materials. Plyboard made from oil palm veneer, must therefore, be improved to meet such requirements.

Malaysian Palm Oil Board (MPOB) has developed a highly durable building material called high-density palm plyboard, using densified resin-treated oil palm veneers. The veneers are bonded together under heat and pressure forming a very tough surface that easily resists abrasion, moisture penetration, and deterioration. The product is more durable than standard palm plyboard, and ideal for use in the above applications.

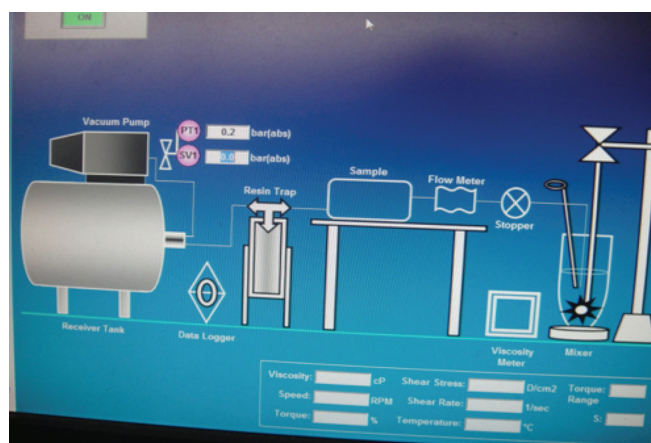
## PROCESS DESCRIPTION

A practical option to minimise within-zone variations in basic properties would be to cross-cut the OPT peeler log into billets, each of 1.5 m long at the log yard. Based on the distribution of moisture content (MC), the billet ends are labelled with codes indicating the position of extremely high MC (pith), high MC (intermediate zone) and moderate MC (peripheral zone). This is to reduce within zone variation in MC and basic density of veneers prior to peeling operations.

Taking into consideration the amount of shrinkage in veneer thickness (ranging between 15.86% and 26.61%), the freshly cut OPT billet is peeled to veneers with a known nominal thickness prior to drying. Such approach is to produce dry veneer of required thickness, in order to produce plyboard

of specified thickness (*i.e.* 5 mm thick, 9 mm thick or 12 mm thick).

After drying, dry oil palm veneers are treated with a phenol formaldehyde (PF) resin using a vacuum infusion method, followed by a densification process. Compared to the open systems such as spray-up and soaking methods, this process has a higher potential for homogeneously depositing the resin within the veneer matrix and reduces environmental harmful charges. *Figure 1* illustrates the set-up of the vacuum infusion system used.



*Figure 1. Flow process of the major stages for impregnation of oil palm veneers with resin adhesive using the vacuum infusion system.*

Impregnation of PF resin is achieved using pressure to drive the resin into the veneer matrix. Dry veneer samples are laid in a flexible and airtight bag with certain positions being opened for resin supply and discharge. The vacuum is applied first prior to the introduction of PF resin in order to extract the air from the veneer cavity. Thereafter, a pressure difference is applied between the inlet of the flexible bag, connected to a resin container under atmospheric pressure, and the outlet of the flexible bag is connected to a pump under vacuum. Once a complete vacuum is achieved, the resin is literally sucked through the veneer samples by a reduction in vacuum pressure at the outlets,

and while keeping the pressure atmospheric (101.3 kPa) at the resin inlets. To circumvent the formation of resin pooling and under-saturation, the flow of PF resin within the veneer matrix is guided by an oscillating vacuum sequence. At the end of the resin filling time, the pressure in the bag is evened out by retaining the vacuum level at the outlets when the resin supply inlet is closed.

The resin-treated veneer samples are then compressed to about 75% of their initial thickness using a cold press. This technique will remove excess resin from the veneer samples and make them more compact. To complete cross-linking of the resin, the densified resin-treated veneer samples are pre-cured in an electric oven. The veneers are then ready to act as semi-finished materials for the production of high-density palm plyboard. Figure 2 illustrates the manufacturing process of high-density palm plyboard.

bending strength of high-density palm plyboard, standard palm plyboard and plywood made from tropical light hardwoods is given in Figure 3.

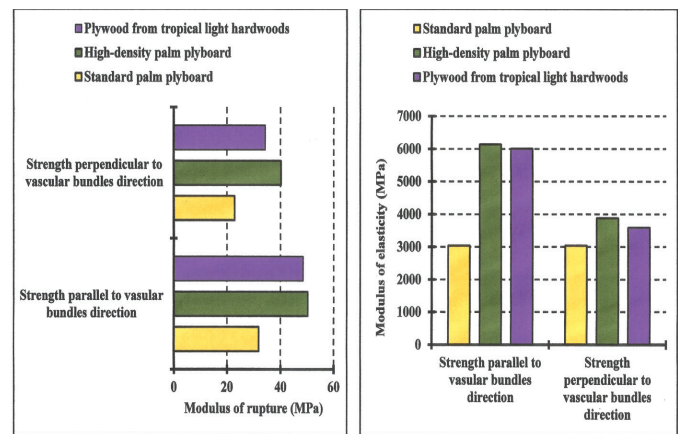


Figure 3. Bending strength of high-density palm plyboard, standard palm plyboard and plywood from tropical light hardwoods.

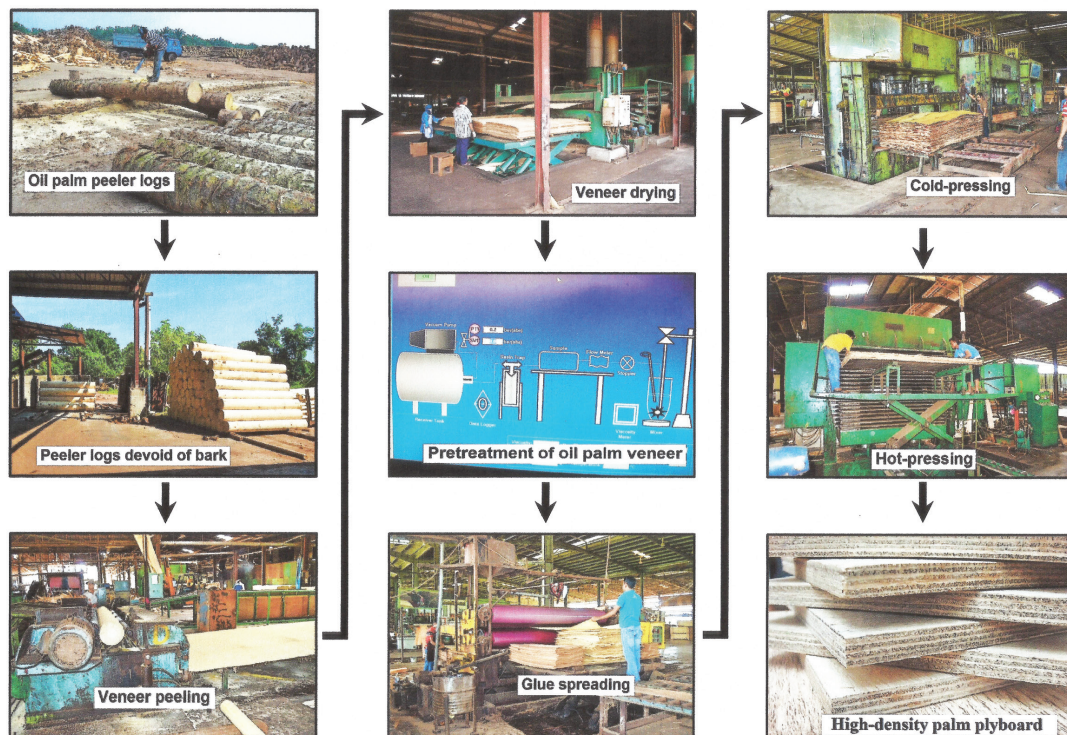


Figure 2. Manufacturing process of high-density palm plyboard.

### STRENGTH PROPERTIES

The product exceeds the minimum strength, bond integrity and dimensional stability requirements as stipulated in BS EN 310 (1993). High-density palm plyboard is superior in bonding shear compared to standard palm plyboard, both in dry and after boiling conditions. This indicates that the product has high strength to weight ratio, is dimensionally stable and provides design flexibility, similar to that of plywood made from wood veneers. The

### COST OF PRODUCTION

The production costs and selling prices of high-density palm plyboard and standard palm plyboard (12 mm thick) are given in Table 1.

### CONCLUSION

For the conversion of OPT into veneer, grading and sorting will be important to firstly segregate based on known properties and optimise the use of the

TABLE 1. PRODUCTION COST COMPONENTS IN PALM PLYBOARD

	Unit	Standard palm plyboard	High-density palm plyboard
Production Costs	RM per m <sup>3</sup>	900	1 000
• Oil palm peeler logs	% per m <sup>3</sup>	30	35
• Overlay (face & back veneers from tropical light hardwoods)	% per m <sup>3</sup>	17	0
• Resin & chemicals	% per m <sup>3</sup>	18	27
• Salary & wages	% per m <sup>3</sup>	24	24
• Electricity & utilities	% per m <sup>3</sup>	5	8
• Repairs and maintenance	% per m <sup>3</sup>	3	3
• Depreciation	% per m <sup>3</sup>	3	3
Selling price (ex-factory price)	RM per m <sup>3</sup>	918 – 955	1 100 – 1 200

heterogeneity in the trunk properties. Although this may involve some additional expenses, there are major savings which can be gained by investors through better yield on usable fractions of the OPT for custom-made products, lower primary and secondary processing costs, and improvements in the product quality. Besides, higher yield equate to less waste and lower manufacturing costs, and thereby, will increase revenues. High-density palm

plyboard would be an option for existing plywood factories to venture into.

#### REFERENCE

BS EN 310 (1993). Wood-based panels. Determination of modulus of elasticity in bending and of bending strength. British Standards Institution. London.

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