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ACACIA MANGIUM FROM SABAH FOR PLYWOOD AND DECORATIVE PANEL MANUFACTURE: INITIAL TRIALS

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WONG, W.C., HO, K.S. & WONG, C.N. 1988. ***Acacia mangium* from Sabah for plywood and decorative panel manufacture: initial trials.** *Acacia mangium* could be peeled and sliced easily. Decorative panel with *A. mangium* sliced veneer as face appeared to be attractive. Phenolic bonded plywood made with rotary cut *A. mangium* veneers met the performance requirement for weather-boil-proof (WBP) grade. However, the bond quality of *A. mangium* plywood using urea formaldehyde adhesive was found to be poor. At 15 years of age, the logs were too small to be economically peeled using existing lathes tailored for peeling big tropical hardwood logs. The small size of the logs, of which some were of poor form, resulted in low recovery rate. Trees for plywood production should be bigger and in better form.

Key words: *Acacia mangium* – slicing – peeling – panel production.

Introduction

Acacia mangium is being planted on a large scale in forest tree plantations in Sabah and Peninsular Malaysia. In this paper, assessment on the suitability of *A. mangium* for the production of plywood and decorative face veneer was carried out. *A. mangium* has also been successfully tried for manufacturing medium density fibreboard (Tomimura *et al.* unpublished, see also Anonymous 1985), as well as fibreboard (Chew & Jaafar Ahmad 1986). Eight logs for the trials were received from the Sabah Forestry Development Authority (SAFODA). Two commercial mills assisted in the slicing and peeling studies since the Forest Research Institute Malaysia (FRIM) does not have any slicing machine and its peeling lathe is unsuitable for small diameter logs.

Production of decorative panels from sliced veneers

Raw material

Four logs which were numbered 1191, 180, 1526 and 1552 were selected for slicing trials. Their characteristics are described in Table 1. These logs were selected for slicing because their forms were poor and were less suitable for peeling into veneers. These logs were first cut into flitches of 2.5 *m* long at FRIM before they were sent to the mill for the slicing trial.

Table 1. Description of logs for slicing

Log No.	Approx. Age (y)	End	Diameter (mm)			Eccentricity of heart (mm)	Sap width (mm)	Description of logs
			Overall	Basic	Mean			
1191	11 2/3	Butt	310	230	270	40	15	The log was slightly curved and fluted. Small and big knots (60 *mm* diameter) appeared at the top end. The ends were oval in shape, having slight star checks.
		Top	240	180	210	15	15	
180	15 2/3	Butt	280	130	205	15	15	The log was crooked and with many knots. The top end was oval in shape, while the butt end was badly deformed. Slight star checks were observed at both ends.
		Top	220	150	175	10	15	
1526	11 2/3	Butt	–	–	–	–	–	The log was twisted. It was free of knots. The top end was oval, while the butt end had buttress up to 100 *cm*.
		Top	290	190	240	20	15	
1552	11 2/3	Butt	270	230	250	20	20	The log was fairly straight. Knots of 30 *mm* diameter appeared around the circumference at 60 *cm* intervals along the length.
		Top	230	190	210	30	20	

Slicing trial

The logs were soaked in hot water for about three days. Following heating, the end splits became more extensive, especially the flitch from log No. 180. The flitches were sliced into veneers with a Taihei slicer. Slicing of the flitches was rated as easy by the operator. The sliced veneers from the four flitches had thicknesses ranging from 0.264 to 0.280 *mm*. The sliced veneers were smooth even at areas around the knots. The colour of the veneers ranged from light to dark brown. The figures on the veneer were attractive due to the presence of darker streaks. There were many knots on the flitches and these knots subsequently appeared on the veneers as well. The presence of knots accentuated the figures. It was also observed that some of the knots were not sound and the centre of these unsound knots occasionally fell off, leaving small holes that required patching.

Formation of decorative panels

The sliced veneers were dried to 18–20% moisture content. The dry veneers were arranged to give a regular pattern and then glued on thin plywood with urea glue. The assembly of veneers and plywood was cold-pressed for 3 to 5 *min* and then hot-pressed for 1½ *min* at 125° *C* to form a piece of decorative panel.

Production of plywood from peeled veneers

Raw materials

The characteristics of the logs bearing numbers 1, 2, 3 and 1807 are given in Table 2. These logs were cross-cut into 1 *m* long billets. Three billets, named A, B and C from the butt-end, were obtained from each log. Billets 1B, 2C, 1807A and 1807B were peeled into 1.6 *mm* thick veneers and billets 1A, 1C, 2A and 2B were peeled into 3.2 *mm* veneers.

Peeling trial

The first peeling trial was carried out using a 1.5 *m* Taihei lathe which had special features to peel small diameter logs such as telescopic spindles and back-up rolls. The second peeling trial was done on an ordinary 1.5 *m* Taihei lathe normally used for producing core veneers.

All the billets were peeled without any pre-treatment. The peeling of *A. mangium* logs was rated as easy by the operators. Because of the small diameter of the logs, recovery rate was low compared to big, round peeler logs normally processed in plywood mills. The logs, being not sufficiently circular in shape, had to be rounded first before usable veneers could be obtained. The rounding-up process led to wastage. Furthermore, the cores also had a tendency to split when the logs were peeled to about 150 *mm* in diameter, further lowering the recovery rate.

Table 2. Description of logs for peeling

Log No.	Approx. Age (y)	End	Diameter (*mm*)			Eccentricity of heart (*mm*)	Sap width (*mm*)	Description of logs
			Overall	Basic	Mean			
1	15 2/3	Butt	420	320	370	0	20	The log was straight. Small knots appeared around the circumference at 50 *cm* from the top end. At the next 60 *cm*, big knots (120 *mm* diameter) and small knots occurred around the circumference. At the next 60 *cm*, knots of 50 *mm* diameter were observed.
		Top	320	230	275	2	20	
2	15 2/3	Butt	380	280	330	2	20	The log was straight, with slight star checks at both ends. Knots of 100 *mm* diameter were found at 60 *cm* and 120 *cm* from the top end.
		Top	290	250	270	10	20	
3	15 2/3	Butt	400	320	360	3	20	The log was straight, with slight star checks at both ends. Knots of 50 *mm* diameter were found at 60 *cm* and 120 *cm* from the top end.
		Top	350	290	320	10	20	
1807	11 2/3	Butt	320	200	260	25	25	The log was slightly sweep with slight star checks at both ends. Few small knots were found at the top end. The top was oval, while the butt end had a triangular buttress. The log had many borer holes.
		Top	270	210	240	10	20	

Since the logs have distinct sapwood and heartwood, the veneers obtained were either light or dark brown in colour depending on whether they were from the light-coloured sapwood or the dark brown heartwood. In some cases, a single piece of veneer could have light and dark coloured zones. Veneers from the heartwood region had dark brown streaks but the figures were less attractive than the decorative veneers from the slicing process. In general, the veneers were smooth.

Drying of veneers

The thinner face veneers were dried at 155°C – 160°C for 12 – 14 *min* thus reducing the moisture content from 77.3 to 6.5%. The shrinkage varied from 6.9 to 4.2% (average 5.6%). During drying, the split extended by 5 to 8 *cm* in length.

The thicker core veneers were dried at the same temperature and required 20 to 23 *min* to lower the moisture content from 96.6 to 7.6%. The average shrinkage was lower at 3.4%. The defects were less as the splits extended by only 2 to 5 *cm*.

Manufacture of plywood from rotary-cut veneers

Both phenol-formaldehyde (PF) as well as urea-formaldehyde (UF) adhesives were used for the gluing trials. Five and six pieces of 90 cm^2 panels were made using phenol and urea-formaldehyde adhesives, respectively. A hand roller was used to spread the adhesives evenly on the core veneer. (The glue spreading machine was not used because of the limited number of veneers for gluing). No glue spreading difficulty was encountered and no difficulty is anticipated in using the glue spreading machine. A glue spread of 220 g/m^2 was used for both adhesives. UF bonded panels were pressed for 3 *min* at 100° *C* while PF bonded panels were pressed for 6 *min* at 109° *C*. These pressing conditions might not be optimum but lack of materials ruled out the use of other pressing conditions.

Assessment of *A. mangium* for decorative panel and plywood manufacture.

Decorative Panels

The decorative panels with *A. mangium* sliced veneer as the face veneer appear to be attractive and are suitable for panelling and furniture making. As compared to teak and nyatoh sliced veneers which have few knots on them, the presence of knots on most *A. mangium* veneers is a feature which may not be readily acceptable to consumers. The success depends very much on the promotion of the decorative features of knots on these veneers by the manufacturers.

Plywood

The peeled veneers are smooth and of acceptable quality. They can be dried easily with shrinkage and defects also falling within the same range as veneers of other species normally used for plywood manufacture.

The bond quality tests were carried out according to the British Standards 1445: 1972 and BS 1203 : 1963. The test results are summarized in Table 3. The bond quality of phenolic–bonded plywood as determined by knife tests indicated that it was barely acceptable for the weather-boil-proof (WBP) grade, although corresponding samples tested in the boil-resistant (BR) condition gave very good results. In the tension-shear tests, both the samples tested in the BR and WBP conditions gave satisfactory results.

Knife test results for the urea-formaldehyde–bonded panels were very poor when tested in the moisture-resistant (MR) condition and were also below acceptable quality when tested in the less severe interior (INT) condition. Corresponding samples tested by the tension-shear method also gave poor results when tested in the MR condition, but the results were acceptable when tested in the less severe INT condition. The results giving INT strength greater than dry strength is unusual and cannot be explained. With other operational conditions such as higher glue spread, different glue formulation or pressing conditions, the findings could be very different.

This preliminary gluing trial indicates that PF–bonded plywood was of acceptable quality but UF–bonded plywood was of low quality. It is pertinent to mention that the results were derived from trials on limited raw material. A more comprehensive study on the suitability of *A. mangium* veneers for the production of MR plywood should be carried out using a greater quantity of raw material.

The colour of the finished product was not uniform, varying from light brown to brown. Colour of the sapwood was an easily distinguishable greyish white. Sapwood of *A. mangium* was easily attacked by borers. The veneers from the sapwood region were marred by numerous borer holes. Wood grain varied from straight to moderately interlocked. The veneers contained numerous knot marks.

Conclusion

Logs of *A. mangium* could be sliced easily. The decorative panels formed by gluing sliced veneers on thin plywood was of acceptable colour and appearance. The presence of many knots on *A. mangium* decorative panels gave rise to figures different from those made with teak or nyatoh veneers which normally have few knots. There is need to promote consumers' acceptance of this particular feature of *A. mangium* decorative panels.

Higher recovery rate of sliced veneers from the *A. mangium* logs could not be attained because of the presence of splits which became even more extensive after heat treatment. Furthermore, some of the logs were small and irregular in shape,

Table 3. Glue bond test

Adhesive	Tension Shear Test										Knife Test				
	DRY Condition		INT		BR		MR		WBP		DRY	INT	BR	MR	WEP
	Failing stress (kg/cm²)	Wood failure (%)	Failing stress (kg/cm²)	Wood failure (%)	Failing stress (kg/cm²)	Wood failure (%)	Failing stress (kg/cm²)	Wood failure (%)	Failing stress (kg/cm²)	Wood failure (%)					
Urea	12.7	61	14.0	40	–	–	7.9	5	–	–	7	4	–	1	–
Phenol	15.8	64	–	–	13.7	44	–	–	13.0	39	8	–	7	–	6

INT = interior condition
BR = boil-resistant condition
WBP = weather-boil-proof
MR = moisture resistant condition
DRY = dry condition

making the conversion of logs into flitch less optimal. Finally, due to the patching up of holes left by some unsound knots, the value of the panel would be lowered as its appearance could be marred especially if the patching up was not done properly.

Although *A. mangium* logs could be peeled easily, the small diameters as well as the irregular shapes lowered the recovery rate. Borer infestation on sapwood gave rise to holes in the veneers from the sapwood and these veneers could only be used in the core.

Plywood-making trials have indicated that *A. mangium* veneers could be made into WBP plywood of acceptable quality, but the MR plywood made from such veneers were of unsatisfactory quality based on the present study. Because of the limited raw material available for the study, it was not possible to vary either the glue spread or the pressing conditions. Hence, it would be premature to rule out the suitability of *A. mangium* veneers for MR plywood manufacture. A more comprehensive study is needed. As for the right glue for *A. mangium* veneers, the expertise in glue technology in this country is quite high and a suitable glue could be formulated without difficulty.

In order to plan for a mill to produce decorative panels or plywood from *A. mangium* logs, the following points warrant consideration:

i) *A. mangium* logs destined for plywood production should be allowed to grow as big as economically feasible before harvesting as the size influences recovery rate to a great extent;

ii) *A. mangium* logs for peeled veneers should preferably be cylindrical in order to reduce wastage in the rounding-up process. The improvement of log form through tree improvement research and silvicultural practices should be considered:

iii) The sapwood is easily attacked by borers and this would reduce the quality of veneers produced from sapwood. A cheap but efficient preservation method should be sought to render temporary protection of logs during transportation and storage; and

iv) In order to maintain production volume, the mill should be designed with special features to process a larger volume of logs per hour with the highest possible recovery. The choice of the peeling lathe is critical. The lathe for peeling small-diameter logs should have more automatic features and rotate faster so that a greater number of logs could be charged to the lathe and peeled. The lathe should have telescopic spindles and back-up rolls so that the logs could be peeled down to about 100 *mm* in diameter instead of 150 to 200 *mm* with normal lathes.

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