MEDIUM DENSITY FIBREBOARD FROM *ALBIZIA FALCATARIA*

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Received April 1988, accepted July 1988.

TOMIMURA, Y., KHOO, K.C., ONG, C.L. & LEE, T.W. 1988. **Medium density fibreboard from** *Albizia falcataria*. Medium density fibreboards or MDF were made from a fast growing tree, *Albizia falcataria.* Four cooking conditions, three using soaked chips and one using air-dry chips, were selected. In the manufacture of the fibreboards at three target densities, urea resin was used as an adhesive. The boards with densities of 0.4, 0.5 and 0.6 *g/cc* generally met the Japanese Industrial Standards JIS 5906 for 50-type, 150-type and 200-type boards respectively, based on the classification of board by bending strength. The thickness swelling of all the boards also met the specifications although no hardeners or wax were used.

Key words: MDF – *Albizia* – steaming pressures – density – board properties.

Introduction

Albizia falcataria (batai), originating from Papua New Guinea, West Irian, the Solomon Islands and the Moluccas, has been planted in the 1980's throughout South East Asia. In the Philippines, it has been successful in plantations. In Malaysia, it has been selected as one of the fast-growing species under the Compensatory Forest Plantation Programme (Yong 1984). The popularity of this species stems from its quick establishment, fast growth rate, especially in the initial stage, and easy natural regeneration since it produces seeds profusely and regularly from an early age.

Although the excellence of batai for pulp (Phillips *et al.* 1978, Semana 1978) and particleboard (Subiyanto *et al.* 1986. Wong & Ong, unpublished) has been established, scant work has been done on fibreboard-making using batai. Semana *et al.* (1982) found that batai hardboards satisfied the requirements of the Philippines Standards and surpassed the properties of locally made commercial hardboards. However, the hardboards made by mixing with bark and other light hardwoods did not generally meet the British Standards in many respects (Silitonga *et al.* 1974).

There are no reports to date on the use of batai for medium density fibreboard. In line with the need to further exploit the potential use of batai, this study was undertaken to investigate the feasibility of the species in MDF manufacturing.

Materials and methods

Materials

Wood samples of 35-year-old batai trees were obtained from the forest plantation at Sungai Buluh, Selangor. The bark was removed before chipping by using the Taihei wood chipper. After screening, chips of suitable sizes (*c.* 2.5 x 2.0 x 0.5 *cm*) were separated for pulping.

Cooking and defibration

Three cooking conditions were used for chips which had been soaked overnight in water, i.e. 6 kg/cm^2 for 10 *min*, 8 kg/cm^2 for 10 *min* and 10 kg/cm^2 for 5 *min*, and one condition of 10 kg/cm^2 for 5 *min* was applied directly on air-dry chips. Cooking was conducted in a Dohoku steam digester. After cooking, the chips were first broken up in a Bauer refiner and then defibrated by a single disc Sprout Waldron refiner with clearance set at 0.3 to 0.4 *mm*.

Boardmaking

Urea resin obtained from a local adhesive company was used as adhesive. The resin content for all boards was 13% based on oven-dry fibres. Wax and hardener were not used. After spraying with resin in a glue-coating machine/blender, the fibres were disintegrated through the breaking plates of a Bauer refiner set at 1.8 *mm* clearance to ensure a homogeneous resin-fibre mix. The condition for hot pressing for all boards was 160°C through a cycle of 5 *min*; 30 kg/cm^2 for 2 *min*; 15 kg/cm^2 for 2 *min*; and 5 kg/cm^2 for 1 *min*. The board size was 25 x 30 x 1.2 *cm* and the target densities were 0.4, 0.5 and 0.6 *g/cc*. The properties of the boards were determined according to the Japanese Industrial Standard, JIS 5906.

Results and discussion

Table 1 shows the yield of fibres from the batai chips and the bulk density of the fibres. No marked differences were observed among the various cooking conditions. With Cook 1, the fibres which appeared the coarsest, had the highest bulk density. Cook 4 gave the highest yield probably because using air-dry chips avoided any loss of the water soluble substances present in the wood.

Table 1. Yield and bulk density of fibres

Cook No.	Yield (%)	Bulk density *(g/cc)*
1	92.7	0.031
2	93.7	0.026
3	91.9	0.030
4	94.3	0.023

Cook 1 : 6 kg/cm^2 for 10 *min* (soaked chips)
Cook 2 : 8 kg/cm^2 for 10 *min* (soaked chips)
Cook 3 : 10 kg/cm^2 for 5 *min* (soaked chips)
Cook 4 : 10 kg/cm^2 *for 5 min* (air-dry chips)

Table 2 gives the results of a screen analysis of the fibres. The largest fibres were obtained from Cook 1. More than 60% of the fibres from this cook were over 1 *mm* in length. Cook 2 gave fibres with the largest proportion of fines under 1 *mm*. The fibres from Cook 3 were rich in medium fraction and the fibres from Cook 4 were rich in both the largest and the smallest fractions.

Table 2. Screen analysis of fibres

Cook	Screen Size				
	< 0.5 *mm* (%)	0.5 – 1 *mm* (%)	1 – 2 *mm* (%)	> 2 *mm* (%)	Total (%)
1	21.7	14.1	32.1	32.1	100
2	33.7	21.6	18.4	26.3	100
3	22.8	21.0	32.4	23.8	100
4	30.2	15.1	19.0	35.7	100

Table 3 shows the properties of all the boards made and tested. The regression between the bending strength and density of the boards is depicted in Figure 1; regression analysis is shown in Table 4. In all cases, a strong correlation between the two parameters is demonstrated. The differences in bending strength between the various cooks are not so clear around the lower density range but become more marked with the increase in density. Figure 1 indicates that at higher densities, boards from Cook 2 give the best bending strength while boards from Cooks 3 and 4 are weaker. Cooking chips at 10 kg/cm^2 was probably too drastic, causing damage to the fibres. Nevertheless, all boards met the specifications of the Japanese Industrial Standards. The boards with density of 0.4, 0.5 and 0.6 *g/cc* met the JIS Standard for the 50-type, 150-type and 200-type, respectively in the classification of fibreboards based on bending strength.

Table 3. Properties of batai medium density fibreboard

Cook No.	Board No.	Board Thickness *(mm)*	M.C. (%)	Density *(g/cc)*	MOR (kg/cm^2)	MOE x 1000 (kgf/cm^2)	IB (kgf/cm^2)	Thickness Swelling (%)
1	1	1.194	7.9	0.419	86	9.5	2.5	8.3
	2	1.195	7.5	0.516	162	16.2	4.3	10.5
	3	1.189	8.5	0.634	313	30.8	8.9	10.2
2	4	1.171	8.6	0.413	97	10.3	1.7	7.6
	5	1.168	7.6	0.501	171	16.6	3.1	8.6
	6	1.170	7.4	0.603	292	28.4	5.0	8.4
3	7	1.175	6.5	0.398	78	7.9	1.2	7.6
	8	1.175	6.3	0.507	147	14.1	4.4	8.8
	9	1.173	7.1	0.602	227	23.6	4.6	9.4
4	10	1.172	6.8	0.421	88	11.1	2.4	7.4
	11	1.174	8.4	0.516	174	20.2	3.7	8.1
	12	1.176	6.9	0.591	245	27.4	5.1	7.7

Note: M.S. = moisture content, MOR = modulus of rupture,
MOE = modulus of elasticity, IB = internal bond.
* 24 *h* water soak test.

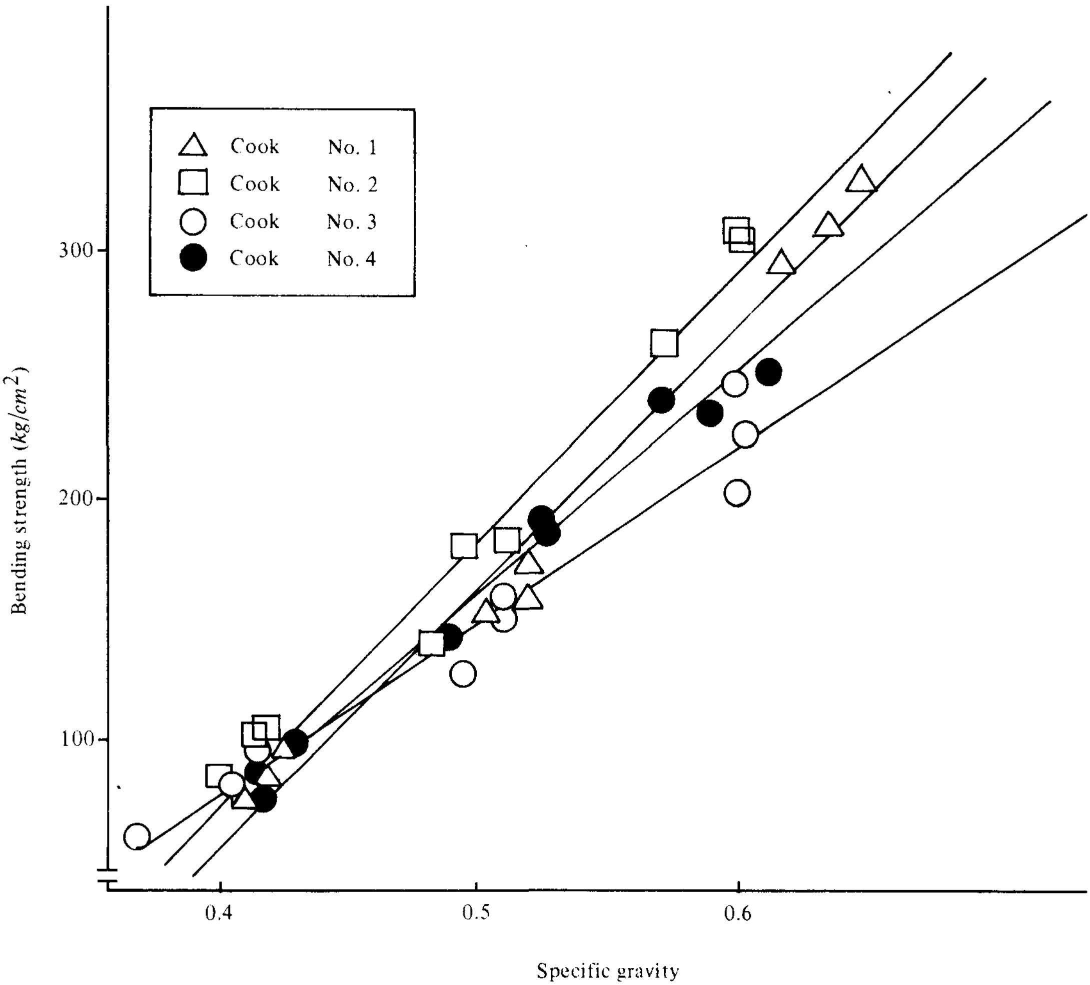

Figure 1. Relationship between specific gravity and bending strength of batai medium density fibreboard

Table 4. Regression analysis of bending strength and specific gravity

Cook	a	b	Correlation coefficient, r
1	–373	1070	0.991
2	–365	1100	0.990
3	–216	729	0.977
4	–299	919	0.991

Note: Y = a + bX, where Y = bending strength, and X = specific gravity.

Internal bond increased with the increase in density of the boards. The boards from Cook 1 were superior to those from the other cooks. The fibres from Cook 1 were the coarsest. The resin content per fibre element was therefore the highest thus accounting for the highest value in internal bond. At the most drastic cooking condition of 10 kg/cm^2, boards made from air-dry chips (Cook 4) displayed better internal bond, just as in bending strength, than those made from soaked chips (Cook 3).

Water resistance decreased with the increase in density of the boards. Higher density boards made by compressing very bulky fibres together have a stronger tendency to regain their volume before compression. At each density level, boards from Cook 1 had the poorest water resistance. A general improvement in water resistance is shown when the steaming pressure was increased above 6 kg/cm^2. At the density of about 0.6 *g/cc*, boards made from the air-dry chips displayed a lower thickness swelling than those made from the soaked chips. All boards however, gave values under 12% in thickness swelling thereby meeting JIS specifications.

Conclusion

Within the three density levels tested in the study on medium density fibreboard from *A. falcataria,* it was found that the species has good promise as a suitable raw material for the manufacture of fibreboard. A low steaming pressure of 6 kg/cm^2 for 10 *min* was adequate to produce boards of good strength, especially in the internal bond of high density boards. However, for best overall results, the optimal condition is a steaming pressure of 8 kg/cm^2 for 10 *min*. There was apparently no advantage in using soaked chips since they gave a reduced yield and produced boards of a slightly lower quality. *A. falcataria,* being a very low density timber, is not likely to be suitable for the manufacture of boards in the higher density range (0.7 *g/cc*) on account of the incidence of blows. As an export material for wood chips, its low density would give rise to a lower free-on-board price.

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