RUBBERWOOD FOR MEDIUM DENSITY FIBREBOARD

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TOMIMURA, Y., KHOO, K.C. & ONG, C.L. 1990. Rubberwood for medium density fibreboard. Medium density fibreboards were made from Malaysian rubberwood. Three cooking conditions using soaked chips were selected. In the manufacture of the fibreboards at three target densities, urea resin was used as adhesive. The boards from fibres obtained at cooking pressure of 6 $kg\ cm^{-2}$ did not meet the specifications for thickness swelling according to Japanese Industrial Standard JIS 5906. The boards from fibres obtained at cooking pressures of 8 and 10 $kg\ cm^{-2}$ with densities of around 0.4, 0.5 and 0.7 $g\ cm^{-3}$ generally met the board specifications for type JIS-50, JIS-150 and JIS-200 respectively based on the classification by bending strength. The internal bond of all boards, especially at density 0.7 $g\ cm^{-3}$, was excellent.

Key words: Rubberwood - MDF - JIS

Introduction

Malaysia, with its large rubber plantations, has a plentiful supply of rubberwood (*Hevea brasiliensis* Muell Arg.). Some 8 to 10 million m^3 including branch wood > 15 *cm* diameter are available annually through the systematic replanting programme of the 2 million *ha* of existing plantations (Anonymous 1986).

The rubber tree yields a useful timber after its economic rotation age is reached after 20 to 25 *y*. Although its suitability for furniture (Anonymous 1986), pulp and paper (Peel & Peh 1961), and particleboard (Wong & Ong 1984) has been established, little has been known of its use for fibreboard manufacture. Peel (1959) found that rubberwood can be made into high grade standard and superhardboard by the wet process.

Among the various wood based panels, medium density fibreboard (MDF) is a relative newcomer. It is gaining popularity because it is particularly suitable for furniture making. Lately, there has been a growing interest among entrepreneurs to examine the investment potential of an MDF industry in Malaysia. Bearing this in mind and the importance of rubberwood as a timber resource which has yet to attain its optimum use in the country, the present study was undertaken to provide a technical assessment of the properties of MDF made from this timber.

Materials and methods

Materials

Rubberwood samples were obtained from 21-y-old trees planted at the Rubber Research Institute of Malaysia experimental station in Sungai Buloh. After the bark was removed, each billet was sawn lengthwise into rough strips for conversion into chips by the Taihei chipper. The chips were dried in the sun and then stored in plastic bags.

Cooking and defibration

The chips were soaked overnight in water and cooked in a Dohoku steam digester. Three conditions were used, namely, 6 $kg\ cm^2$ for 10 *min*, 8 $kg\ cm^2$ for 10 *min* and 10 $kg\ cm^2$ for 5 *min*. After cooking, chips were defibred by a single disc Sprout Waldron refiner with clearance set at 0.3 to 0.4 *mm*.

MDF manufacture

Urea resin (obtained from a local adhesive company) was used as adhesive. The resin content for all boards was fixed at 13% based on oven dry fibres. Wax and hardener were not used. After spraying with resin in a glue-coating machine, the fibres were passed through the breaking plates of a Bauer refiner to ensure a homogeneous fibre-glue mix.

The condition of hot pressing was 160°*C* for 5 *min* with the following press cycle for all boards: 30 $kg\ cm^2$ for 2 *min*; 15 $kg\ cm^2$ for 2 *min*; and 5 $kg\ cm^2$ for 1 *min*.

Board size was 25 × 30 × 1.2 *cm*, and target densities were 0.5, 0.6 and 0.7 $g\ cm^3$. The properties of the boards made were determined according to Japanese Industrial Standard (JIS) 5906.

Results and discussion

The pulping yield of fibres from the rubberwood and the bulk densities of the fibres are shown in Table 1. The yield of the fibres decreased with increase in steaming pressure. This drop was caused probably by the degradation of polysaccharides, a large amount of which is found in rubberwood. These polysaccharides form furfurals during drastic steaming, and could have been easily lost during the blow-out of steam after the digestion of the chips was over. The bulk density of the fibres also decreased with the increase of steaming pressure. In Cook 3, the fibres had the lowest bulk density which was below half that of Cook 1.

Table 1. Pulping yield and bulk density of fibres

Cook number	Cooking condition	Yield (%)	Bulk density ($g\ cm^3$)
1	6 $kg\ cm^2$ for 10 *min*	97.6	0.061
2	8 $kg\ cm^2$ for 10 *min*	92.0	0.043
3	10 $kg\ cm^2$ for 5 *min*	90.8	0.029

Table 2 gives the results of the screen analysis of the fibres. The longest fibres were obtained from Cook 3. Nearly 60% of the fibres from this cook were over 1 *mm* in length. On the other hand, Cooks 1 and 2 gave a large proportion of fibres under 0.5 *mm*. This accounts for the lowered bulk density of Cook 3.

Table 2. Classification of fibres

Cook number	Screen size (*mm*)				Total (%)
	< 0.5	0.5 - 1	1 - 2	> 2	
1	62.9	14.5	15.7	6.9	100
2	72.8	14.6	5.4	7.2	100
3	28.5	14.0	17.8	39.7	100

The physical properties of all the boards tested are shown in Table 3. The relationship between the bending strength and density of the boards is depicted in Figure 1 .

In all cases, a strong correlation between the parameters is demonstrated. The bending strength of boards from Cook 1 was not as strong as those from Cooks 2 and 3. Cooking rubberwood chips at 6 $kg\ cm^2$ was probably not sufficient for proper subsequent defibration, explaining for the highest bulk density of the fibres from this cook. The boards with density of about 0.5, 0.6 and 0.7 $g\ cm^3$ met the Japanese Industrial Standard specifications for the 50-type, 150-type and 200-type boards respectively in the classification of fibreboards based on bending strength.

The internal bond increased with increase in density of the boards (Table 3) . All boards, especially with density > 0.7 $g\ cm^3$, had excellent internal bond over 10 $kgf\ cm^2$. Even the lowest internal bond strength registered, which was over 4 $kgf\ cm^2$, satisfied the 200-type board of the Japanese Standard, JIS. Thus, with respect to the internal bond, rubberwood is excellent raw material for MDF manufacture.

Table 3. Properties of rubberwood medium density fibreboard

Cook number	Board number	Board thickness (*mm*)	M.C. (%)	Density (*g cm*$^{-3}$)	MOR (*kgf cm*$^{-2}$)	MOE × 1000 (*kgf cm*$^{-2}$)	IB (*kgf cm*$^{-2}$)	T.S. (%)
1	1	1.205	8.1	0.513	88	9.6	4.1	13.2
	2	1.201	8.1	0.602	148	17.1	5.7	14.7
	3	1.202	7.6	0.703	216	20.7	10.9	14.3
2	1	1.185	7.8	0.501	95	9.4	5.1	10.5
	2	1.180	7.3	0.608	189	17.6	5.8	10.9
	3	1.173	7.5	0.707	276	23.2	10.2	11.1
3	1	1.183	7.3	0.506	103	10.7	5.1	9.3
	2	1.181	7.3	0.598	180	17.7	6.6	10.4
	3	1.175	7.2	0.710	274	24.8	11.2	10.3

(M.C. = moisture content, MOR = modulus of rupture, MOE = modulus of elasticity, IB = internal bond, T.S. = thickness swelling after 24 *h* water soak)

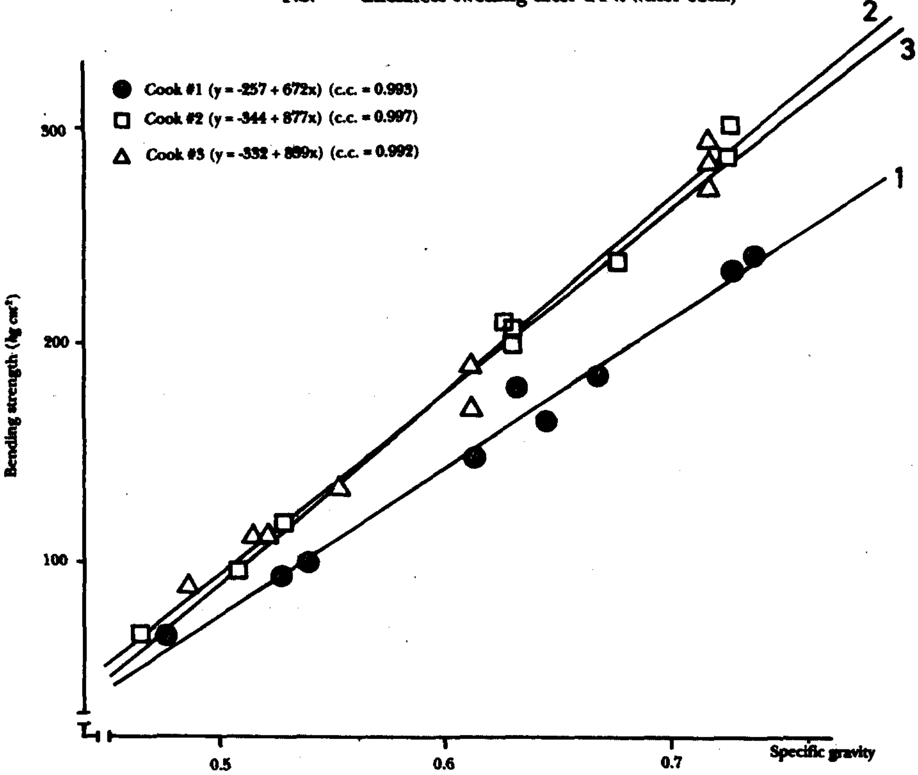

Figure 1. The relationship between the specific gravity and bending strength of rubberwood medium density fibreboard

The water resistance of the boards from rubberwood was not so good (Table 3). At each density level, boards from Cook 1 had the poorest water resistance. The thickness swelling of these boards was > 13% and did not meet the specifications of JIS which stipulates a value of < 12% in thickness swelling. A general improvement in water resistance is shown when the steaming pressure of the chips was increased over 6 *kg* cm^{-2}. The boards from fibres obtained under such higher pressures met the specifications. Nevertheless, incorporation of wax emulsion as additive could have improved the water resistance and thickness swelling .

Conclusion

Rubberwood can be used as a promising raw material in the manufacture of medium density fibreboard. However, to obtain boards of acceptable properties, the chips have to be cooked at pressures > 6 *kg* cm^{-2}. The boards generally displayed excellent internal bond strength. Although the water resistance was on the high side, this can be improved through the addition of wax emulsion during blending of the fibres. A vast improvement in strength properties was exhibited when the board density was increased from 0.6 to 0.7 *g* cm^{-3}. The optimum conditions for boardmaking were obtained from chips cooked at 8 *kg* cm^{-2} for 10 *min* and boards made at a density of about 0.7 *g* cm^{-3}.

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