PROPERTIES OF THREE-LAYER MUF PARTICLEBOARD FROM BAMBOO (*GIGANTOCHLOA SCORTECHINII*)

JAMALUDIN KASIM
Wood Technology Department, Faculty of Applied Science, Universiti Teknologi MARA, Jengke Campus, 26400 Jengka, Pahang Darul Makmur

ABSTRACT

In the study of high moisture resistant particleboard from bamboo (*Gigantochloa scortechinii*), three-layer melamine urea-formaldehyde particleboard was produced. Increasing core particle size does not greatly affect the mechanical properties but improved the dimensional stability of the boards. Wax addition increased the board stability towards water exposure but decreased the mechanical properties of the boards. All boards surpassed the minimum requirement of the BS for the mechanical and physical properties. Particles from three-year-old *Gigantochloa scortechinii* was suitable for the making of three-layer melamine urea-formaldehyde particleboard.

INTRODUCTION

All over the world the forest resources are dwindling due to the development of the wood industry and population increase has increase tremendous pressure on the needs for new raw materials. Bamboo plantations now play a crucial part of social forestry in many developing countries. The world over there is 1,250 species of bamboo and occupies about 14 million hectares and distributed mainly in the tropical and subtropical zones (Zhu 1995). However, most of the bamboo forests in the world are not managed intensively and are usually characterized by low productivity.

In Malaysia, of the 50 bamboo species found, 13 are being widely used in the various bamboo industries.bamboo. Buluh semantan (*Gigantochloa scortechinii*) is the commonest bamboo found in the wild and presently are used in large quantities in the manufacture of basakets, higo products, incense sticks and parquetries (Abd. Latif 1987). Abd has reported the basic properties of G. scortechinii. Latif et al. (1994) and Abd. Latif (1996). However no published report on its utilisation in the making of composite products has been found.

This paper discusses the particleboard properties of three- layer particleboards produced with melamine urea formaldehyde (MUF) resins. The influences of core particle size and wax addition are included in the discussion.

MATERIALS AND METHODS

Sixty bamboo clums from three-year-old bamboo (*Gigantochloa scortechinii)* were harvested from managed bamboo clumps in FRIM, cut into 2 m length and splitted longitudinally using a bamboo splitter. The bamboo splits were fed into the Pallmann drum chipper and the chips produced were then flaked in the Pallmann drum flaker. After flaking the particles were air-dried for one week to reduce the moisture content prior to oven-drying and were subsequently placed in an oven at 60 C until the moisture reaches about five percent. The oven-dried particles were then screened into less than 0.5, 0.5-1.0, 1.0-2.0 and more than 2.0 mm sizes using a circular vibrating screen.

Three-layer particleboard were produced with particle sizes of 1.0-2.0 and > 2.0 mm as core material and 0.5-1.0 mm as surface furnish. The surface and core resin content was maintained at 12 and 10%, respectively. The melamine urea-formaldehyde resin used in the study had a solid content of 65%. The hardener (ammonium chloride) solution with a concentration of 20% was used. The amount of hardener added was equivalent to 3% of the weight of the resin solution used.

For board manufacture a weighted amount of particles was placed in the Drais glue mixer and sprayed with a resin mix containing resin, hardener, wax and water. The glue mix was sprayed as a fine mist at an air pressure of 0.4 MPa in order to obtain an even distribution of resin over the bamboo particles. After spraying, the sprayed particles were then manually laid in a wooden mould over a caul plate with a dimension of 34 x 34 cm and then pre-pressed with a cold press at 3.5 MPa for 30 seconds. The consolidated mat was then finally pressed to the required thickness of 12 mm at 160°C for 6 minutes with the maximum pressure at the metal stops at 120 kg cm-2. The target density was approximately 721 kgm^{-3}. A total of three boards were produced for each condition.

All the boards produced were cut according to a cutting plan adopted from BS EN 326-1: 1994 (Anonymous 1994) made to obtain a random selection of test samples throughout the board size of 340 x 340 mm. The test samples were tested for its mechanical: modulus of rupture (MOR), modulus of elasticity (MOE) and internal bond (IB), and physical properties: water absorption (WA) and thickness swelling (TS) according to British Standard BS EN: 1993 (Anonymous, 1993). Screw withdrawal (SWE & SWS) tests were conducted according to BS 5669 (Anonymous 1989). All the mechanical tests were conducted using an Instron Universal Testing Machine Model 4204.

RESULTS AND DISCUSSIONS

Properties of Three-Layer MUF Particleboard

The strength and dimensional properties of three-layer MUF particleboard are tabulated in Table 1. With an increase in core particle size (PS), the strength properties of MOR and MOE showed a decreasing trend but the dimensional properties (TS1, TS24, WA1 & WA24) are all improved. Wax addition showed a definite decreasing trend for all strength properties but better dimensional properties were observed.

Bamboo particles of 1.0-2.0 mm with wax exhibited the lowest MOR (26.35 MPa), IB (0.53 MPa) and WA24 (26.59%) and without wax addition produced the highest MOE (3888 MPa) and also the highest MOR (29.13 MPa). The lowest SWE (557 N) was produced by boards made from >2.0 mm particles with 1% wax addition. Wax addition decreases the bonding ability of the resin thus causes a decrease in mechanical strength. Lowest TS (1.87%) was exhibited by boards made from > 2.0mm particles. The better dimensional stability of boards with wax is due to the wax ability to resist the intake of water by the particle surface. In general, all the boards, irrespective of wax addition, showed high mechanical and good physical properties. They all surpassed the minimum requirement for physical and mechanical properties of the BS and MS. Particles of *G. scortechinii* are suitable for the manufacture of three-layer MUF particleboards.

Table 1: Physical and Mechanical Properties of Three-Layer MUF Particleboard

Age (yrs	Wax (%)	Core PS (mm)	Board density (kgm^{-3})	MOR (MPa)	MOE (MPa)	IB (MPa)	SWS (N)	SWE (N)	TS1 (%)	TS24 (%)	WA1 (%)	WA24 (%)
3	0	1.0-2.0	726	29.13	3888	0.87	865	778	4.68	27.12	25.51	75.60
	1		764	26.35	3825	0.53	740	565	2.07	11.46	6.91	26.59
3	0	>2.0	745	28.23	3723	0.88	951	785	4.02	23.99	15.07	64.91
	1		745	26.76	3752	0.62	844	557	1.87	10.60	4.76	29.40
BS	5669			min. 13.80	min. 2000	min. 0.34	-	min. 360	max. 8.00	-	-	-

Note: PS - Particle size, MOR - Modulus of rupture, MOE - Modulus of elasticity, IB - Internal bond, SWS - Screw withdrawal surface, SWE - Screw withdrawal edge, TS1- Thickness swelling 1 hour, TS24 - Thickness swelling after 24 hours, WA1-Water absorption after 1 hour, WA24 - Water absorption after 24 hours

CONCLUSION

Three-year-old *Gigantochloa scortechinii* particles are suitable raw materials for the production of three layer melamine urea formaldehyde particleboards. All boards made from both 1.0-2.0 mm and > 2.0 mm particles surpassed the minimum requirements of the BS 5669.

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