PROPERTIES OF PARTICLEBOARD FROM KENAF (*Hibiscus Cannabinus L.*) CORE AND ACACIA (*Acacia Mangium)*WOOD

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Abstract

In this study acacia particles were mixed with kenaf core partricles with ratios of 10, 30 and 50% and produced into particleboard with a resin content of 7% using urea formaldehyde resin. The target board density was 700 kgm^{-3}. From the study it was shown that mixing ratio between acacia and kenaf core particles significantly affected the physical and mechanical properties of particleboard. Boards without any addition of kenaf core showed the highest result for both mechanical and physical properties while boards with 50% addition had the lowest results. All boards made from kenaf core and acacia at all mixing ratios fully satisfied the minimum requirement for the mechanical properties based on European Standards (EN 310). However all boards failed to meet the minimum requirement for the TS value of 12%.

Keywords: Particleboard, Mixed Kenaf core and Acacia, Urea Formaldehyde (UF)

INTRODUCTION

Particleboard is a composite wood-based panels manufactured by compressing small wood particles consisting of varying shapes and sizes of particles of lignocelluloses materials bounded together with adhesive under heat and pressure. Wood supply is decreasing in developed countries around the world while wood supply in developing countries has poor pounds of wood resources for particleboard manufacturing. Consequently, non-wood fibers play an important role in providing a balance between supply and demand (Kalaycıoglu et. al., 2006).

Particleboard is a well established raw materials for industrial usage. However, the increasing price of wood has leads to alternative sources of raw materials for particleboard manufacturing. Alternative source can be developed by mixing wood and non-wood materials by using acacia tree (*Acacia Mangium*) and kenaf (*Hibiscus Cannabinus L.*) core to reduce the solid wood as the main material.

Acacia mangium is a species of flowering tree in the pea family, Fabaceae. This tree is widely used in Goa in the mining industry for rehabilitation of the waste dumps as it is a drought resistant species and binds the sterile mine waste consisting of lateritic strata. Like many other legumes, it is able to fix nitrogen in the soil (Hoong, 2009).

Kenaf (*Hibiscus Cannabinus L.*) on the other hand, has a combined long and short fibers for paper and paperboard products (Stricker et. al,. 2007). The core however, has no utility in the automotive applications and is often discarded. The effectively uses of kenaf core is considered to be one of the new sustainable lignocellulosic raw materials (Okuda et. al., 2003). Kenaf core is the waste from the kenaf tree in wood manufacturing. Therefore, turning kenaf core from a useless waste into a more useful and valuable raw material is undeniably a good way of managing the waste. The waste from kenaf core is a good resource to reduce the use of wood as the main material in the manufacture of particleboard and it is also environmentally friendly. The objective of this study is to evaluate the suitability of kenaf core as admixture to acacia wood in particleboard production. The physical and mechanical properties of particleboard and the effects of varying kenaf core ratios were determined.

MATERIAL AND METHODS

Three *Acacia mangium* trees were harvested in the UiTM Jengka, Pahang forest. Kenaf (*hibiscus cannabinus l.)* core were supplied by Lembaga Kenaf and Tembakau Malaysia in Kuantan, Pahang. The Acacia trees and kenaf core were chipped separately, and flaked to produce small particles of the desired thickness and length. After air drying for 1 week, the particles were screened to remove the oversized and fine particles. The particles collected for the study were in the range of particle size less than 2.0mm and more than 0.5mm. The particles were than oven dried in the oven dry at 80^0C 24 hours to reduce the moisture content to below than 5%.

A weighted amount of particles are placed in the particle mixer and sprayed with urea formaldehyde resin at 7% resin content. The particles consists of four ratios of acacia and kenaf core; 90%:10%, 70%:30%, 50%:50% and 100%. After mixing the sprayed particles formed manually in wooden mould with dimensions of 35 cm X 35 cm. After mat forming the boards are then cold press to consolidate its thickness at 300 psi pressure for about 30 seconds. The consolidated mat was then hot pressed in a thermal-oil heated hydraulic hot press at a temperature of 165°C. After hot pressing the finished boards are then cooled to room temperature. The boards were the cut into test pieces in accordance to the EN Standards for particleboard testing. The test pieces were tested for MOR, MOE, IB, WA and TS.

RESULTS AND DISCUSSION

Mechanical and physical properties of mixed acacia and kenaf core particleboard

Table 1 shows the mechanical and physical properties of mixed kenaf core and acacia particleboard. The result showed that MOR (24.04 MPa) and MOE (3239 MPa) and IB (0.87 MPa) for panels using 100% acacia was higher compared to panels produced with other ratios. The best TS (0.45%) were shown by boards made with 50%:50% ratio of acacia: kenaf core.

All boards made from kenaf core and acacia at all mixing ratios fully satisfied the minimum requirement for the mechanical properties based on European Standards (EN 310). However all boards failed to meet the minimum requirement for the TS value of 12%.

Table 1: Mechanical and physical properties of mixed kenaf core and acacia particleboard

Ratio	**Density (kgm^{-3})**	**MOR (MPa)**	**MOE (MPa)**	**IB (MPa)**	**TS (%)**
100*	647	24.04	3239	0.87	16.34
90*	644	22.44	3219	0.81	16.50
70*	645	22.04	3096	0.69	17.05
50*	660	19.44	2726	0.45	20.41
BS EN		>14.00	>2000	>0.5	<12.00

* Acacia mangium particles

Effect of Mixing Ratios

Bending Properties

Figure 1 shows the MOR and MOE of mixed acacia and kenaf core particleboard made at different mixing ratios. The results showed MOR and MOE were significantly affected by the addition of kenaf core materials during board manufacture. Boards with 100% acacia particles are 24% better in MOR value when compared with boards with 50% acacia particles. MOE vale was also 19% better for 100% acacia board when compared with boards made with 50% acacia particles. This is probably due to the nonwoody component of the kenaf core which does not provide good bonding with acacia particles.

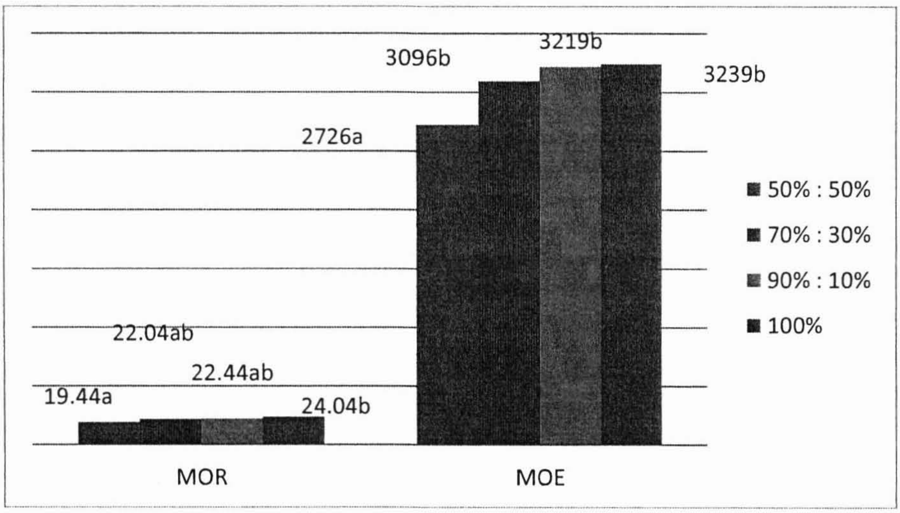

Figure 1: Modulus of rupture (MOR) Modulus of Elasticity (MOE) of mixed kenaf core and Acacia particleboard

Internal bonding strength (IB) and thickness swelling (TS)

Figure 2 shows the effects of mixing ratios on the internal bonding strength (IB) and thickness swelling properties. Similar trend as shown on properties of MOR and MOE is also shown on the IB properties of the boards manufactured. IB value of 100% board with acacia particles is 102% higher than those boards that have 50% acacia particles. Board with 100% acacia particles also exhibited the best TS of 16.05% which is 21% better that boards with 50% acacia particles.

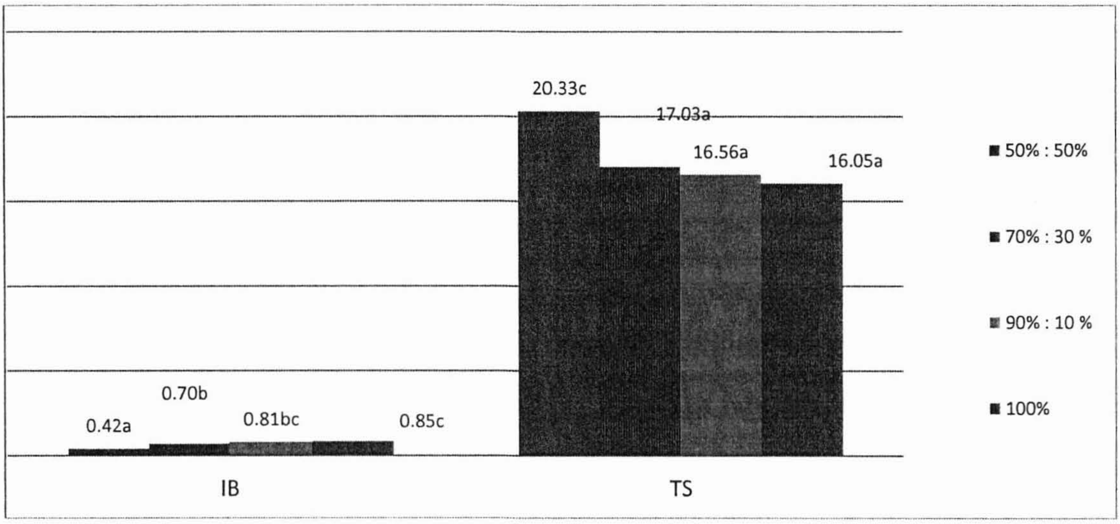

Figure 2: Internal bonding strength (IB) and thickness swelling of mixed kenaf core and acacia particleboard

CONCLUSIONS

From the study it was shown that mixing ratio between acacia and kenaf core particles significantly affected the physical and mechanical properties of particleboard. Boards without any addition of kenaf core showed the highest result for both mechanical and physical properties while boards with 50% addition had the lowest results. With addition of 7% resin content it can be concluded that kenaf core is not a suitable material to be use with acacia particles in the production of particleboard using urea formaldehyde resin.

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