PROPERTIES OF PARTICLEBOARDS MADE FROM RUBBERWOOD (*Hevea brasiliensis*) AND KENAF (*Hibiscus cannabinus L.*) CORE.

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Abstract

This study investigates the potential of kenaf core (KC) as a substitute material to rubberwood (RW) for producing particleboard. RW particle were mixed with KC particle with ratio 10, 20, 30, 40, and 50% produced into 700 kgm^{-3} target density particleboard with resin content of 10% using urea formaldehydes resin. By handling this investigation, mixing ratio between RW and KC particle are significantly affecting the physical and mechanical properties of board. The additional of KC particle showed the decrease of both physical and mechanical properties of board. The modulus of rupture (MOR) of 50% mixing of KC particle were decrease 28%, modulus of elasticity (MOE) decrease 24%, internal bonding (IB) decrease 47%, TS increase 50%, compare with board of 100% RW particle. All mixing ratios are exceeding the minimum requirement for the mechanical properties based on European Standard (EN 310) except for physical properties where the minimum requirement for thickness swelling (TS) value could not achieved 12%.

Keywords: Particleboard, rubberwood (Hevea brasiliensis) , kenaf (Hibiscus cannabinus L.), Urea Formaldehyde (UF)

INTRODUCTION

Consolidation of wood particles or other lignocellulosics material particle with the addition of adhesive which been pressed with desired pressure and heat to become a panel material is called as particleboard (Anonymous,1992). There are several classification of particleboards can be described according to its criteria. Malaysia has produced particleboard that is generally with densities of 600 to 800 kg/m3 and with thickness range of 6 to 40 mm (Chew, 1979).

Particleboard can be manufactured by various type of wood, but most preferred is the rubberwood (RW) which is obtained from the rubber tree or its scientific name "*Hevea brasiliensis*". The usage of RW has been on the rise nowadays. Factors that are associated to this demand are that it ensures quality in terms of its properties besides being flexible to cut it in different shapes and sizes. It is also light in weight and possesses attractive looks. The most attractive aspect of it is that quality RW can be purchased with an affordable price. It is a favorite's wood among the Environmentalists as cutting it does not cause much influence on the climate. The life cycle of rubber trees is short. They can be grown quickly by means more wood can be obtained in a less period of time and it has become economically significant especially in the manufacturing of particleboard.

Recently, crisis arose where resources of RW has deficient. This has reduced the availability of RW. Hence, the price has increased tremendously. To overcome this shortage, new resource which is kenaf has been introduced in order to reduce the use of RW in particleboard making. Every part of kenaf is precious where they are used to produce variety of goods, unlikely the core is commonly being discarded. Therefore, in this study, KC is chosen as a portion of raw material to reduce the amount of RW used in particleboard manufacturing.

According to history, kenaf was found 4,000 years ago in ancient Africa. It is a member of the hibiscus family and related to cotton and okra. There are two distinct fiber types that make up the kenaf stalk. The term "bast" is used for the outer fiber which comprises roughly 40% of the stalk's dry weight. Another 60% of the stalk's dry weight consists of the inner fiber which is called the "core". The core is said to have high moisture absorption and low microbial resistance. The whole kenaf plant can be processed as raw material for a growing number of products including particle board. The objectives of the study are to determine the mechanical and physical properties of particleboard produced from rubberwood and its admixture with kenaf core.

MATERIAL AND METHODS

Important materials to be prepared are the particles of RW and KC as the main components and also the urea formaldehyde adhesive that acts as bonding material. The particles of RW in chip form were obtained from DongHwa Factory which is located in Nilai, Seremban. The KC was supplied by the Lembaga Kenaf dan Tembakau Negara, Malaysia in the form of bulk shape. Both materials were being transformed to smaller particles by using the ring knives flaker separately. The particles were being air dried for one (1) week before being screened with size range between 0.5mm to 2.0mm. The screened particles were then being oven dried for 24 hours at temperature of 80°C to achieve moisture content below 5%.

Next, weighted ingredients were blended in glue mixer where the resin was sprayed at the air pressure of 0.4 MPa. This is to ensure an even distribution of resin over the particles. After mixing process, the mixture was laid on an appropriate wooden mould having the dimensions of 350mm x 350mm as a step for mat forming. To form the mat, the mould had undergone pre-press action which is known as cold press process at a pressure of 3.5 MPa for 30 seconds. To obtain the required thickness of 12 mm, the mould was then been further press which is determined as hot press using standard thermal-oil heated hydraulic hot press at 165°C for 6 minutes (Jamaluddin, 2006). The board was conditioned for one (1) week. Lastly, the particleboard was cut for further testing according to EN standards for particle board testing. The samples were tested for MOR, MOE, IB and TS.

RESULTS AND DISCUSSIONS

Table 1 shows the mechanical and physical properties of particleboard according to the mixing ratios of rubberwood and kenaf core particles. The result showed that MOR (19.58 MPa), MOE (2710 MPa) and IB (1.53 MPa) for panel using 100% RW particle was higher compared to panels produced with other ratios except for TS (30.65%) which has lowest value

Table 1. Mechanical and physical properties of different ratio particleboard.

RATIO (%)	MOR (MPa)	MOE (MPa)	IB (MPa)	TS (%)
100*	19.58	2710	1.53	30.65
10-90*	18.62	2568	1.37	33.62
20-80*	17.84	2432	1.25	36.56
30-70*	16.40	2295	1.10	39.42
40-60*	15.22	2136	.95	42.48
50-50*	14.09	2052	.80	46.04

*RW particle

Figure 1 and 2 shows the MOR and MOE values according to the mixing ratios. Increasing the ratio of KC decreased the strengths of the panel which value of MOR were decreased by 4.9%, 8.8%, 16.2%, 22.3%, and 28% respectively. The MOE also showed the same trend with MOR. 100% RW panel had the highest stiffness value of 2710 MPa. The value of MOE decreased approximately 5% with increased the KC ratio. This may be explaining by the high RW particle density (Lim et al, 2003).

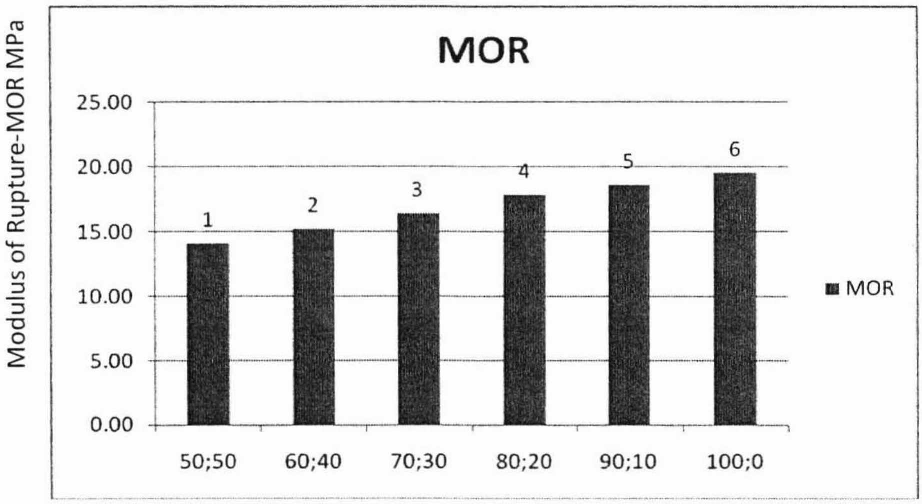

Figure 1. The MOR values of six (6) different ratios.

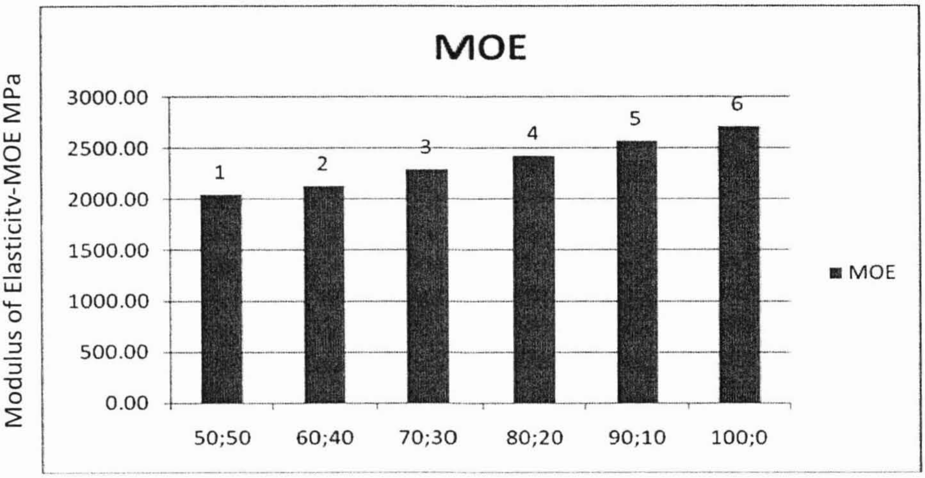

Figure 2. The MOE values of six (6) different ratios.

Figure 3 demonstrates that, the IB strengths of 100% RW panel was highest than the other ratios. The figure also shows that the trend in IB was similarly to the trends observed in MOR and MOE. Panel with high amount of RW particle have highest bonding strengths and the value were decrease respectively. By increasing 10% ratio of KC particle, the value of IB was continuously decreased approximately 10% except ratio of 20% KC particle was decreased 7.5%. This is because, distribution of the employed resin is a factor that contributes to the low strength of KC particleboards. Particles surfaces may not being covered entirely by the binder during mixing, but rather the adhesive stayed in the form of droplets on the surfaces of the KC particles. KC is a naturally absorbent material (Lips et al, 2009).

Another factor that may contributes to the decreasing of IB value is the light material of KC implies a high volume of particles, hence the particles covered by resin were decreased as the KC ratio increased. All six (6) ratios of samples were fully satisfied the minimum requirements for MOR, MOE and IB according to European Standard (EN310).

Figure 4 shows the result of physical properties. 100% RW particle panel had lowest TS value. As the ratio increased 10, 20, 30, 40 and 50% of KC particle, the TS value were significantly increased by 2 to 4%. Generally, low density wood and high absorbent material such as KC could have high value of TS as the samples were submerged in water. Therefore, light material of the KC which implies that a high volume of core particle is needed to produce the target panel density of 700 kg/m3 (Juliana et al, 2012). Furthermore, UF resin is not designed for direct contact with water.

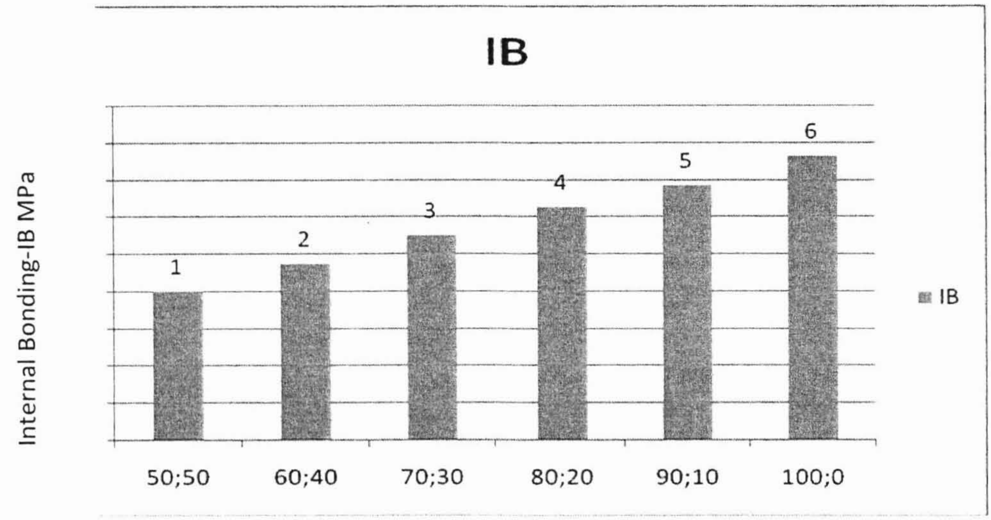

Figure 3. The IB values of six (6) different ratios.

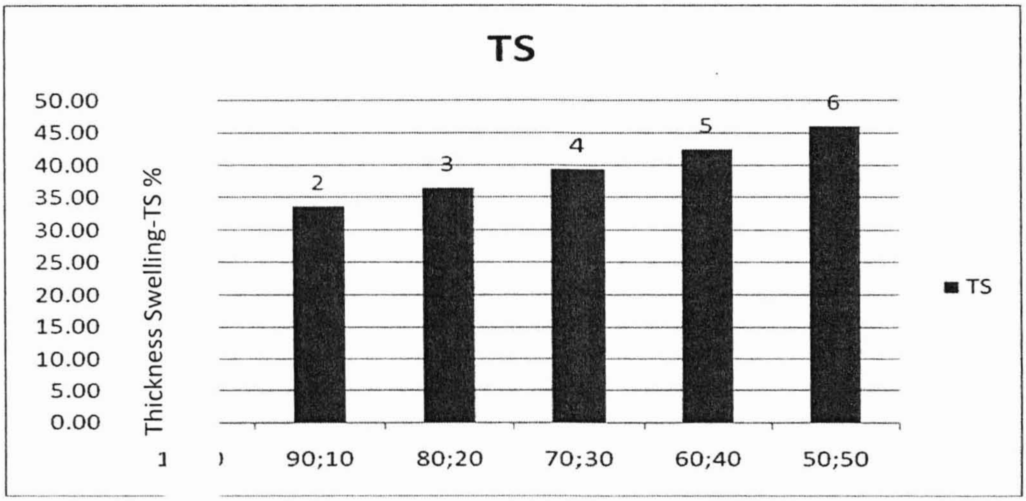

Figure 4. The TS values of six (6) different ratios.

CONCLUSIONS

From the study that has been conducted, mechanical and physical properties of board are significantly decreased. Additional of KC particle caused the board become less stable in both properties. This has been proved by the result of 100% RW board has highest value of MOR, MOE and IB while lowest value of TS compared to board with additional ratio of KC. It is believed that TS value could not achieved minimum requirement because of the UF resin used as binder is not suitable as it is design for the purpose of interior usage. It is recommended to add wax or use other bonding materials that are design to resists water.

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