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The Effects of Heat and Compression on Moisture Content and Water Absorption of PALF/Sugarcane Bagasse Composition in Disposable Plate Production

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Abstract. This paper presents the results of heat and compression effects on moisture content and water absorption properties in the manufacturing of disposable plate made from Pineapple Leaf Fiber-based material (PALF). The plate was made of PALF and sugarcane bagasse waste as an alternative to polystyrenes, designed to promote the green technology effort on food packaging material. Two different specimens were produced with different compositions of PALF/sugarcane bagasse series N2T8 (20 wt% of Pineapple leaf fiber and 80 wt% of sugarcane bagasse) and series N8T2 (80 wt% of Pineapple leaf fiber and 20 wt% of sugarcane bagasse). The specimens were produced using a hot press machine set at compressing temperatures of 50°C, 100°C and 150°C with constant pressure of 0.024 MPa for 10 minutes. Moisture content and water absorption tests were carried out on the specimens to determine the moisture content and water absorption properties. The lower water absorption was obtained for specimen N8T2 because PALF potential to water resistance. This range of properties is expected to be good enough for the requirement of disposable plate and it has the potential as a suitable raw material for strength and lightweight in the manufacturing of disposable plates.

Introduction

Paper plate are ubiquitous since 1904. The extensive researches have been reported on non-wood as nature fibres as alternative fibres sources in production of paper due to the decreasing of wood source and to reduce the pollutions [1-5]. For example of non-wood fibres are wheat [1] and rice [2] straws, sorghum [3] tobacco [4] stalk and banana [5] used as a raw material for pulp and paper production. China uses more than straw and other non-wood as a raw material for paper production [6]. Malaysia interest to agriculture as natural fibers are introduced because they are lower in cost and lower in density as compared to glass fibers [7-8]. Mustapa and co-workers [9] have been done investigated the effect of heat compression on tensile strength in pineapple leaf fibre (PALF) and sugarcane bagasse percentage of paper sheet. The result shows that the increase of heat compression would be beneficial for enhancing the tensile strength. However, the heat and compression effects on moisture content and water absorption in PALF and sugarcane bagasse could be clarified. In the present study, to investigate the process ability of PALF and sugarcane bagasse as a raw material for disposable plate at different heat compression temperatures. The moisture content and water absorption behavior were investigated.

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Material and Methods

PALF and sugarcane bagasse waste used were collected from a Pineapple farm located in Batu Pahat Johor. Fig. 1(a) shows the schematic of the process used for material preparation and to produce the paper plate. The raw materials of PALF and sugarcane bagasse were cut and washed with water to remove dirt. The materials also was immersed in water mixed with sodium hydroxide with the ratio of 10:1. Then the water was heated to 100°C within 20 minute and this temperature was maintained for 24 hours. Then, the fiber was removed and blended using commercial blender machine and mixed with sugarcane bagasse at different composition series N8T2 and N2T8 respectively. A mold (34 cm (length) x 34 cm (Width) x 13 cm (thick)) and a heat compression machine were used to produce 24mm size paper plates as shown in Fig. 1b, The samples were then dried in an oven at 60 °C for 24 hours. Fig. 2 shows the sample disposable plates.

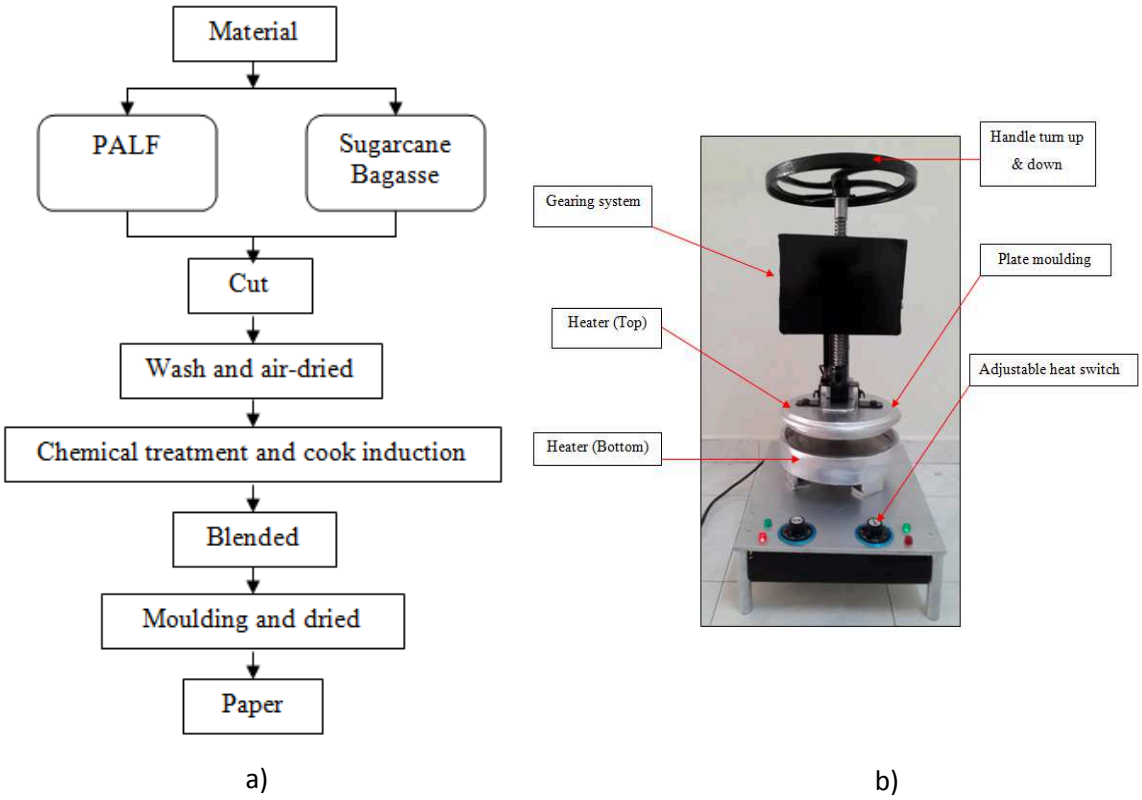
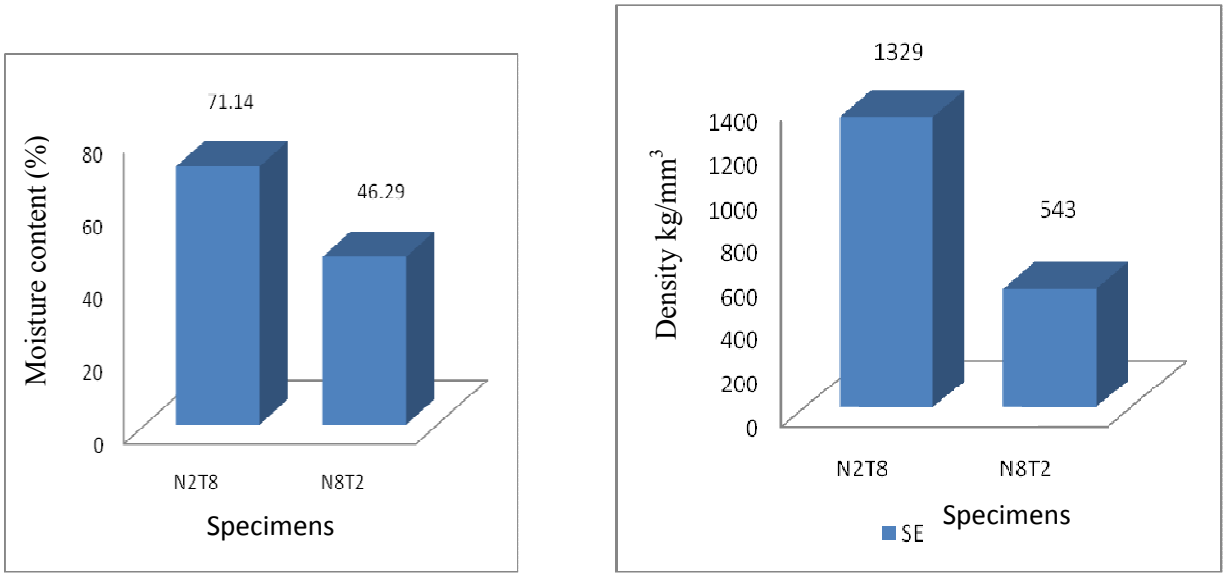


Figure 1: a)Schematic Specimen preparation b) Hot press machine for disposable plate producing

Figure 2: Sample disposable plates

Results and Discussion

Higher density in natural fibers results in higher water moisture content which is a very important property that determine the general strength of the resulting paper products [9-10]. Fig. 3(a) shows the result of moisture content for two different samples. From the results, the moisture content was decreased when the composition of PALF/sugarcane changed to a higher PALF. Water absorption and their resulting effects contribute to the loss of compatibilization between fibers and matrices which results in debonding and weakening of the interface adhesion [11-14]. Density of fiber affects the rate of water absorption on the fiber as shown on Fig.3 (b). Fig. 4 shows that at the temperature of 150 °C, the lowest percentage of water absorption occurs on specimen N8T2 which is 60.26%. These indicate the higher temperature might be beneficial for PALF as compared to the bagasse. In addition, the increase of heat shows of the specimen changing circumstances of composition characteristic.



(a) (b)

Figure 3**:** Effects of (a) moisture content (b) Effect of density on PALF/ sugarcane bagasse composition

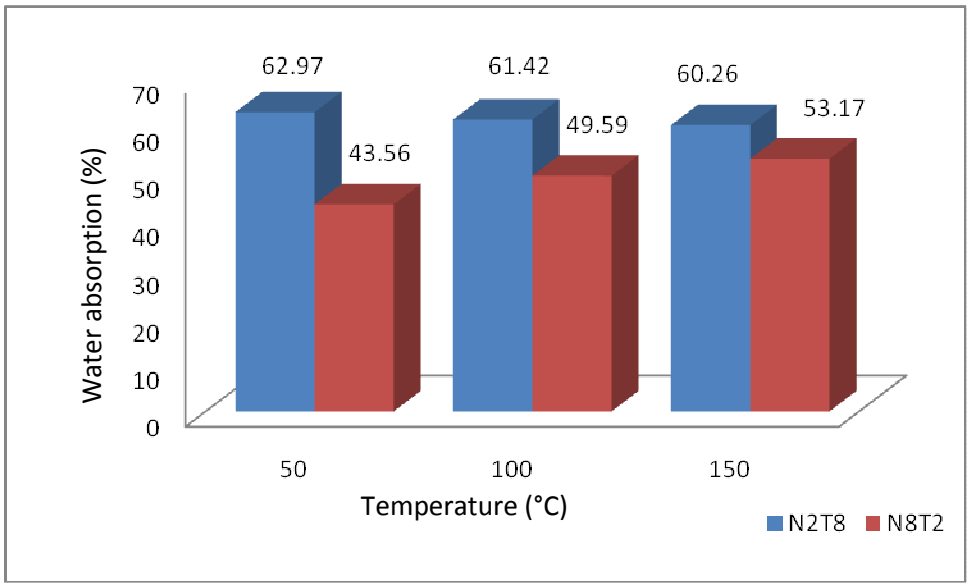


Figure 4: Effect of temperature on water absorption

Conclusion

This research work provides basic information on nature fiber development forms waste material for plate disposal. The presented work is related to the mechanical behavior and the effect of compression temperature for moisture content and water absorption has been conducted. The large composition of sugarcane bagasse waste in composite paper plate shows the moisture content, density and water absorption characteristic increasing. The PALF fiber type plate is more hydroscopic and water resistance than bagasse waste. The surface roughness was smooth on disposable plate at lowest PALF percentage. The higher heat treatment indicates the rough surface for the specimens.

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