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Wettability Properties of Coconut Fiber on Resin

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Abstract: ***This research investigates the effect of alkali treatment on the ability of wettability in cocout fiber composites to measure contact angle, resin Polyester is dripped on untreated fiber (green fiber) and fiber that has been soaked in 3% NaOH solution for 1, 2, and 3 hours. After drying, the matrix droplet on the fiber is observed with a microscope equipped with software for analysis. Substantially, contact angle the value will be smaller after alkalization so the quality of the bond will increase, because the surface of the fiber becomes coarser and porous and the loss of the lignin layer and other impurities. With the increasing of the bonding quality between fibers and matrices, it is believed that the strength of coco-polyester fiber composites will increase compared to fibers without alkali treatment.***

Keywords: droplet, able to wet, coco fiber, contact angle

1. Introduction

The development of technical materials today leads to the discovery and exploitation of cellulose-based natural materials or biomaterials which have beneficial aspects in terms of both economic and environmental technologies [1]. For example PT Toyota in Japan has utilized composite materials kenaf fiber as a component of interior panel of ensemble cars. Besides manufacturers Daimler Bens's car too has utilized the abaca fiber as a reinforcement of composite materials for dashboard. this technology tend to be based on the nature of the composite reinforcing seat which is more environmentally friendly. This composite also has a strength to high density ratio so that the components are made more efficient. Industrialists uses the composite as a superior product according to its distinctive features contact angle with synthetic fibers, natural fibers have several advantages which include the ability to be decomposed by lightweight bacteria, renewable, high mechanical properties and unlimited availability [2]. Besides that, natural fibers do not cause abrasives on equipment to have neutral CO emissions and as an important source for improving the welfare of the surrounding community [3].

In composite materials, the bond between fiber and matrix will affect its characteristic properties involving Wettability [4]. The wettability parameters are determined by the contact angle formed between the matrix and the fiber surface and interfacial bonding. The adhesion properties between fibers as reinforcement and matrix greatly affect the mechanical mechanical properties [5]. Often interfaces are obtained by modifying the surface chemical properties of the fibers to optimize the adhesion properties between the fibers and the matrix [6]. This can also be controlled by surface energy analysis which is the problem of whether the alkali treatment of fibers will increase the bond between fiber and matrix [7,8]. One way to find out fiber and matrix bonds is to recognize the properties of fiber wettability by dripping matrix liquid into fibers to get contact angles including the goal of this research is to know the effect of alkaline treatment (NaOH 3%) on the bond between faces coir fiber composites with polyester matrix. Quantitative measurement method involving contact angle () between the surface of the matrix fiber gives a liquid placed on the surface on the surface as in figure 1. The smaller the contact angle the wettability gets better so the matrix as a fiber adhesive medium must have the ability to coat the surface area of the surface, optimally.The contact angle to produce optimal wet capability is no more than 30% [7]. Quantitively wettability is shown by contact angle (θ) between solid fiber and liquid matrik in droplet form.

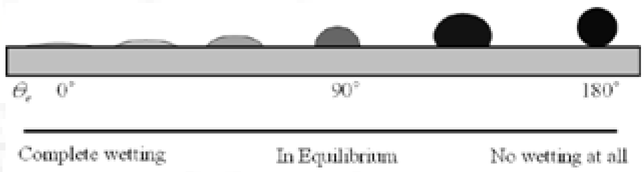


Figure 1: Level of wettability according to the size of the contact angle [9]

2. Research Method

Coconut husk is decomposed to get fiber manually. Fiber is divided into two parts, namely untreated fiber and fiber with initial treatment. Fiber with pretreatment is soaked with 3% NaOH solution with a time variation of 1, 2 and 3 hours After soaking the fibers washed with distilled water to remove the chemical effects on the fibers and dried without heating the sun. After drying the fibers were taken randomly as many as 30 fibers for each variation of immersion time and placed on the U profile which was given a double tip on both sides then the polyester matrix was dripped onto it mixed with Mekpo 1% (fig 2).

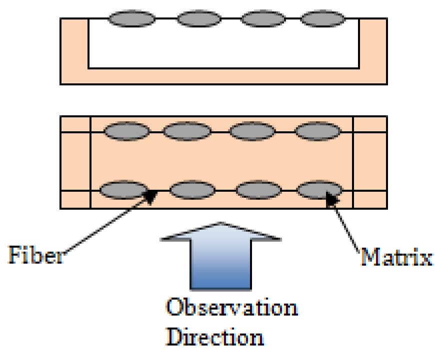


Figure 2: Schematic of making contact angle test objects

Observation of the formed contact angle was observed with Zeizz microscope and its supporting software AxioCamLCc

1. The contact angle was determined using the weibull F (θ) distribution function which was formulated as follows :

$$F(\theta)=1-exp\left[-\left(\frac{\theta}{\theta_o}\right)^{\beta}\right] 0 \leq \theta < \infty \,, \beta > 0 \,, \theta_o > 0 \quad (1)$$

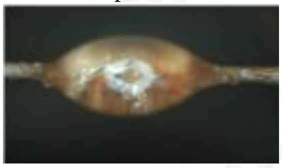
$$\mu = \theta_o.\Gamma\left(1+\frac{1}{\beta}\right) \quad (2)$$

$$SD^2 = \theta_o^{\,2}\left[\Gamma\left(1+\frac{2}{\beta}\right)-\left[\left(1+\frac{1}{\beta}\right)\right]^2\right] \quad (3)$$

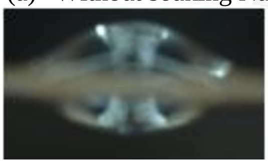
With θ contact angles, β = Form parameters, θo= Scale parameters, μ = average contact angle, SD = Standard deviation, Γ = Gamma function. The scale parameter (θ_0) is determined in conditions where In In [1 / 1-(Fθ)]=0, while the form parameter (β) or Weibull modulus is the slope determined from the In In [1/1-(F (0)] and In θ

3. Results and Discussion

Images 3 shows the results of a microscope photo of a polvester droplet on coco fiber with optical magnification 20 x.Table l. shows the consequent changes the matrix will be more easily level absorption of fibers against matrik (polyester. mekpo1 %) before and after NaOH treatment. Indications of this change can be seen from the deviation (standard deviation) that occurs, where the longer the immersion time the value of deviation will be smaller. The longer the fiber is soaked with alkali, the more absorbed matrix will be more and more with fiber that does not have alkaline treatment so that itwill minimize the angle between the surface of the fiber and the liquid droplet of the matrix This is because the surface of the fiber becomes cleaner and deterioration of dirt including lignin attached to the fiber.Figure 3a shows that the liquid matrix when it is still liquid is difficult to enter the pores of the fiber because it is blocked by dirt and other impurities.



(a) Without soaking NaOH



(b) Soaking 3% NaOH (1 hour)

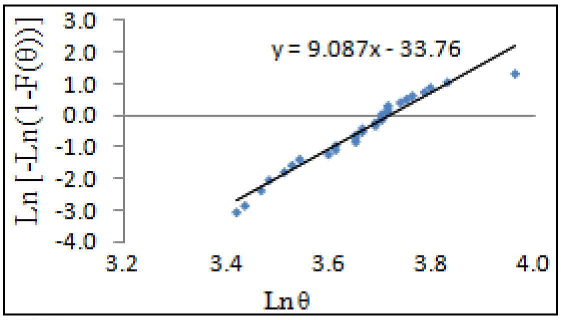
(c) 3% NaOH immersion (2 hours)

(d) 3% NaOH immersion (3 hours)

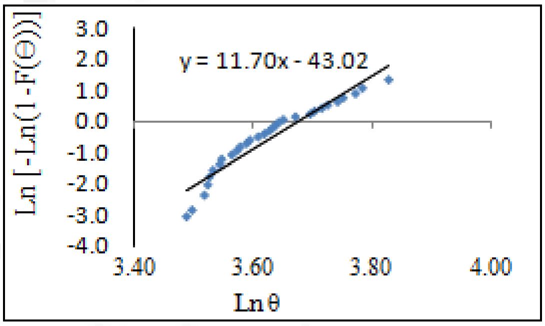
Figure 3: Droplet polyolester + Mekpo. 1% on single fiber

Table 1: Weibull parameter values and contact angle between fibers and polyester

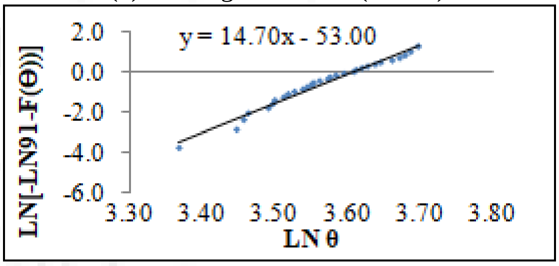
Immersion Time (Hours)	*Weibull Parameter*		*Standard Deviation (SD)*	*Contact Angle (θ^0)*
	β	*θ_0*		
0 hour	9,09	40,50	4,7795	44,95±4,78
1 hour	11,70	38,35	3,5774	41,34±3,58
2 hours	14,70	36,66	2,7403	39,67±2,82
3 hours	20,55	32,55	1,9096	34,20±1,76



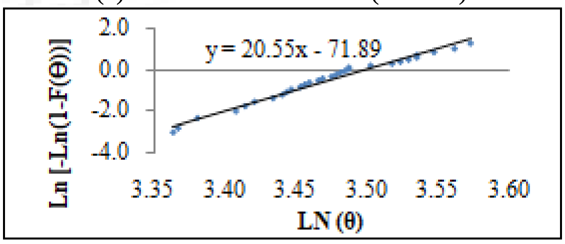
(a) Without soaking NaOH



(b) Soaking 3% NaOH (1 hour)



(c) 3% NaOH immersion (2 hours)



(d) 3% NaOH immersion (3 hours)

Figure 4: Weibull distribution of contact angle at various times of immersion

The results showed that the contact angle between the tangents of polyester droplets and fibers was influenced by the length of immersion at% NaOH concentration. Changes in the value of the contact angle due to NaOH treatment are also indicated in the figure 4. Figure 4 (d) shows the distribution of contact angles that occur, where the contact angle value has a smaller design than other graphs. Changes in the value of the contact angle are also seen in the change in the Weibull parameter value, the greater the form (β) parameter, the scale parameter (θo) will be small followed by the deviation and the average contact angle value Table 1. Physically, the data informs that the contact angle will be smaller with 3% alkaline immersion for 3 hours. Changes in the value of the contact angle due to alkali treatment caused, among other things, the surface of the coco fiber to have wax and other substances besides other impurities. This condition prevents the penetration of matrices in fibers so that the absorption is smaller and directly lignin impurities and layers reduce adhesion properties. Alkaline treatment causes the penetration of the matrix when it is still wet, so that the matrix will be absorbed more by the fiber. This happens because the surface of the fiber becomes cleaner than dirt and lignin layers and other impurities. Another effect due to alkali treatment is that the surface of the fiber becomes more and porous, making it easier for the matrix to be absorbed easily by the fiber (Figure 5).

a. Non Treatment NaOH b. Treatment NaOH

Figure 5: Cross section view of single coir fiber obtained in an optical microscope using a 20 x objective

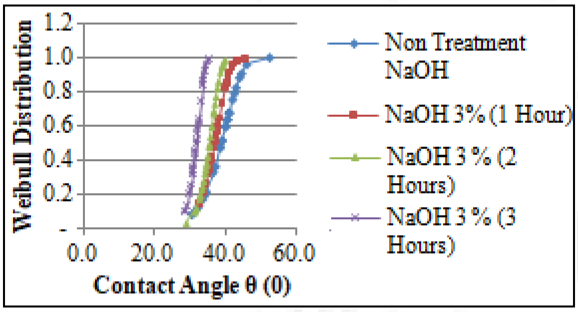


Figure 6: Weibull Distribution

Changes in contact angle values due to the length of alkali treatment (3 % NaOH) are also shown in figure 6. The graph shows the distribution of the results of contact angle measurements before and after exposure to NaOH. Before immersion the distribution chart is on the right and after immersion the distribution graph NaOH styles are on the right and after immersion the NaOH distribution graph moves to the left. This phenomenon shows that there is a change in contact angle to be smaller with respect to soaking time. This is caused by the surface of the fiber after immersing the NaOH fibers become cleaner because some components such as dirt, lignin and wax are released due to the reaction between fiber and NaOH solution. Besides that the surface of the fiber becomes more coarse and porous as shown in figure 5. Fiber does not experience brownish colored alkali treatment of suspected elements of the bond between the micro fibers that make up into a single fiber and the other components are attached to the fiber surface [11].

4. Conclusions

Alkaline treatment (NaOH) can improve the wettability of coconut fiber with a pohyester matrix which is indicated by a decrease in the contact angle value. The alkaline treatment causes the surface to become clean from dirt and others purities but the surface becomes rough . Therefore, initial treatment with alkali in coco fiber is needed to increase the bond between fiber and matrix

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Author Profile

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