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A Characteristic of Ijuk Palm Saray Composite with Resin Polyester

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Abstract

Renewable material gives low impact to environment such as biofiber reinforced composite. A composite was made from ijuk palm saray mixing with resin polyester is a good material as a bumper car. Ijuk is a kind of natural fibers that was rinsed in solution of sodium hydroxide for a range of time then the fiber was cut of into 21 cm in length. Those fibers (ijuk) were arranged as rectangular across to others over an aluminum foil as a molding. Into the preparative, liquid polyester containing catalyst was poured to 2mm thickness. After the blend was to be hardness, the blend was pressed to get a composite preparative. The preparative then was tested its density, tensile strength, impact strength, flexural strength and modulus elasticity. The composite were made in a range of variation concentration rinsed ijuk, 1, 2, and 3% volume to resin polyester and given tensile strength, flexural strength and impact strength average was 12.103 MPa., 32.103 MPa and 5300 J/m^2 respectively.

Keywords: Ijuk palm saray, volume fraction, period of rinse, tensile strength, flexural strength , impact strength.

INTRODUCTION

Natural fibers, as reinforcement, have recently attracted the attention of researchers because of their advantages over other established materials. They are environmentally friendly, fully biodegradable, abundantly available, renewable, cheap and have low density [1,2]. Plant fibers are light compared to aramid fibers such as glass, carbon. Polymeric materials reinforced with synthetic fibers such as glass, carbon and aramid provide advantages of high stiffness and strength to weight ratio as compared to conventional construction materials, i.e. wood, concrete and steel. In spite of construction materials, i.e. wood, concrete and steel[3-5]. Although these advantages, the widespread use of synthetic fiber reinforced polymer composite has a tendency to decline because of their high-initial costs and also production of synthetic composites requires a large quantum of energy and quality of environment suffered because of the pollution generated during the production and recycling of these synthetic materials[5]. In recent time plant fibers have been receiving considerable attention as substitutes for synthetic fiber reinforcements. Unlike the traditional synthetic fibers like glass and carbon these lignocelluloses fibers are able to impart certain benefits to the composites such as low density, high stiffness, low cost, renewability. biodegradability and high degree of flexibility during processing [7,8].

Palm saray or fishtail palm named in England is a palm that well growth in Indonesia mainly at Berastagi [9]. Perdinan Sinuhaji et.al reported that ijuk palm saray contains cellulose 35, 22%, halo cellulose 58,32%, and its fibrous 1.59 mm in length, 17.09 μm inner diameter averages. Density and tensile strength 1.283g /cm^3 and 377.37 MPa respectively [10].

When the ijuk was rinsed on a solution of NaOH 5% by a variation time 0; 1; 2 ; 3 and 4 h as well variation volume fraction fiber showing a different topography to initial material. In this paper, the rinsed fiber obtained has been formed to a composite with addition polyester resin by following hand lay –up method.

EXPERIMENT

Preparation of rinsed ijuk palm saray.

The work was followed by the procedure reported. Choosing ijuk palm saray 0.36 – 0.45 mm in average outer diameter, rinsed with fresh water for 24 h, removal it and dried in air. Then the dried ijuk placed in a container containing a solution of NaOH 5%, for 1; 2 ; 3; and 4h [10]. These ijuk were removed to a stream of water till no caustic residual. Further, those ijuk let dried in air [11].

Preparation of composite board

Into a molding, the dried and clean ijuk was arranged as rectangular position [12] and poured a matrix containing a mixture of unsaturated resin polyester 157 BQTN-Ex with methyl ethyl keton peroxide (MEKPO) 1% [13]. The variation ratio ijuk to the resin was made 1., 2., and 3% w/w.The all

mixture then was pressed on 1000 kg for 12 h to obtain composite board [14].

Physical test

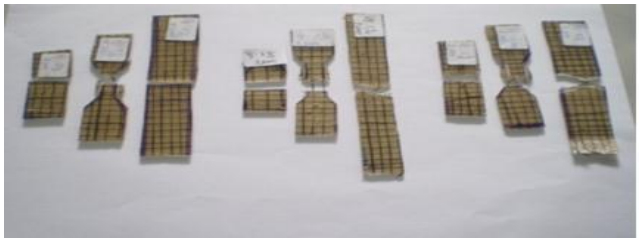
The board composite was cut according the standard test. For tensile strength following ASTM D-256 (85 mm x 13 mm x 2,2 mm) [15], flexural strength following ASTM D-790 (120 mm x 20 mm x 2,2 mm) [16] and impact strength following ASTM D 638-08 (85 mm x 20 mm x 2,2 mm) [17]. Density measured following method reported [18].

RESULTS AND DISCUSSIONS

Ijuk palm saray is present at local Indonesia area. The profile of the plant is depicted at Fig. 1 below.

(a)

(b)

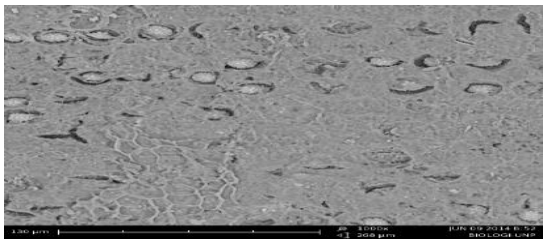


(c)

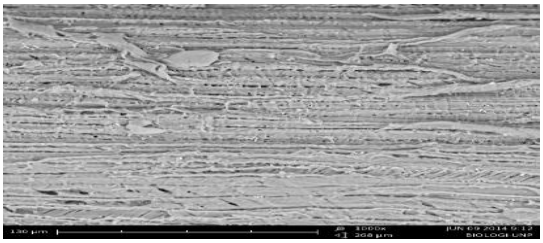
Figure 1: The profile of the plant of (a) Natural ijuk palm saray tree, (b) Ijuk palm saray, (c) Sample test composite

Effect treatment ijuk palm saray with NaOH 5% solution

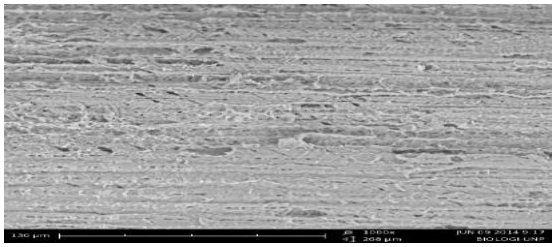
The observation on surface treated ijuk palm saray was conducted with scanning electron microscope (SEM). The surface shows a different profil from the original is presented at Fig. 2 below.



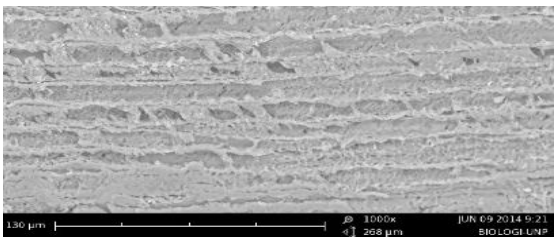
(a)



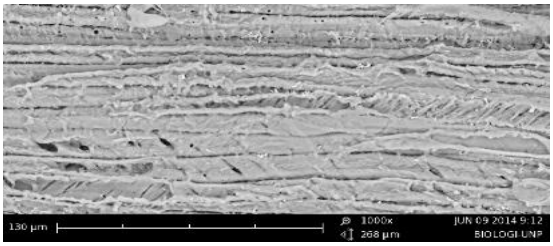
(b)



(c)



(d)



(d)

Figure 2: The profil of surface ijuk palm saray of (a) Original, (b) Rinsed NaOH 5%,1h, (c) Rinsed NaOH 5%,2h,

(d) Rinsed NaOH 5%, 3h, (e) Rinsed NaOH 5%, 4h.

The increasing rinse time, the more smooth surface resulting due to lignose cellulose partly removal. However, ijuk palm saray surface was slight destroyed at 4 h rinsed time.

Effect rinsed time and fraction volume to physical test

The formation of composite board was made by mixing the clean rinsed ijuk palm saray with the matrix under several parameter compositions.

Table 1: Effect rinsed time of ijuk to physical properties of composites

Composite	Rinsed time (h)	Fraction volume (%w/w)	Physical Test			
			Density (g/cm3)	Tensile strength (MPa)	Flexural strength (MPa)	Impact strength (J/m2)
1	0	1	1.612	5.769	6.438	1923.40
2	1	1	1.408	7.126	14.250	3680.01
3	2	1	1.408	10.000	18.363	2160.60
4	3	1	1.407	6.900	32.114	1907.51
5	4	1	1.407	4.510	17.638	2094.42
6	0	2	1.612	6.743	7.660	2211.91
7	1	2	1.311	7.275	8.287	2398.89
8	2	2	1.311	9.242	11.129	2496.71
9	3	2	1.310	13.185	9.989	2465.40
10	4	2	1.310	10.388	8.854	2348.11
11	0	3	1.612	6.743	7.660	2211.91
12	1	3	1.311	7.275	8.287	2398.89
13	2	3	1.311	9.242	11.129	2496.71
14	3	3	1.310	13.185	9.989	2465.40
15	4	3	1.310	10.388	8.854	2348.11

Composite 1 to 15 were made from the treated ijuk palm saray on a solution of NaOH 5% as described on Section 3.1 above. Rinsed time gives effect on physical properties. The tensile strength, flexural strength and impact strength shows high change after 2 and 3 hours rinsed time. A characterization of the surface can be obtined as the SEM photos at Figure 2c and 2d above. This effect is coused by the surface changed.

Effect rinsed time to density composite

The plot of period rinsed time of the ijuk to density of composite can be observed in Fig. 3 below

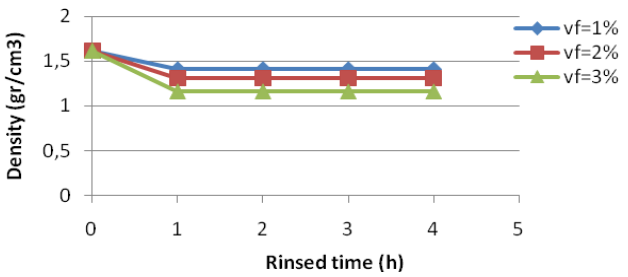


Figure 3: Rinsed time vs density

A decreasing density of composite was found when the ijuk palm saray was rinsed for 1 hour. The fraction volume of the trated ijuk at 1., 2., and 3 % gives liniearly decreasing change to density. It means the density on the trated ijuk much influence to the density of the composite does not change to effect decrase as. Composite ijuk palm saray with polyester has density avarage 1.23 gr.cm^3. The effect of reinforced natural fiber on composite has also been reported such as sisal, banana, and choir. The densities were higher than 1.1 gr/cm^3 so this ijuk composite is simillar to coir composite 1.288 gr/cm^3 [19, 20].

Effect on Tensile strength

The rinsed time of ijuk gives respond to tensile strength composite. The Fig. 4 below shows that the strength was the highst when the ijuk was rinsed for 3 hours under volume fraction ijuk 2 %. The strength of composite is depended on the formulation ratio support to polyester. The compatible ratio of ijuk might have at 2 %.

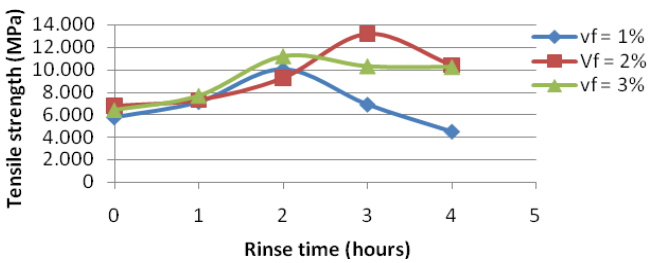


Figure 4: Rinsed time vs. tensile strength

Flextural strength (FS)

The rinsed time of ijuk affect to flexural strength of composite. From Fig. 5 below, Rinsed time at 3 hours, FS shows the maximum with fraction volume 3%. Diharjo *et al.* [21] found that the flexural strength of kenaf-polyester composites increased with increasing in percentage of fiber volume fraction.

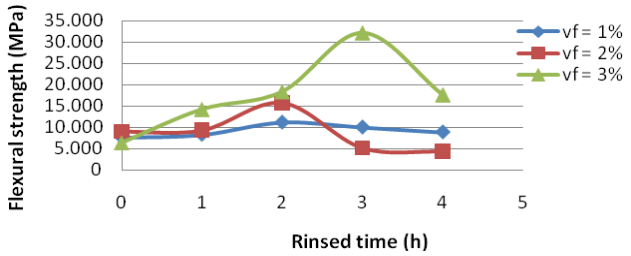


Figure 5: Rinsed time vs. flexural strength

Impact strength

Impact strength is affected by ijuk provided by rinsed time at 2 hours with volume fraction 3 % in Fig. 6 below.

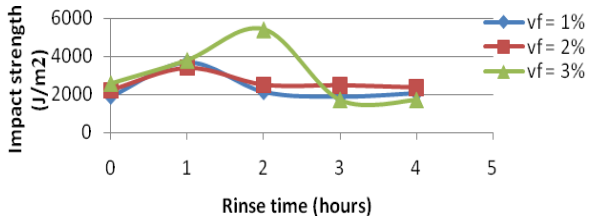


Figure 6: Rinsed time vs. impact strength

There has been investigated that physical properties of the composite is important on rinsed time. In rinsed time 2 hours with fraction volume 3 % resulting impact strength 5408,22 J/m^2. It may have a strong absorbed polyester to the treated ijuk with the coustic solution. The surface of treated ijuk to be expanded and increasing hydroxyl group leaving by lignin. However, hydroxyl group will change to eter after two OH group resulting water molecule catalyzed by coustic.

Composite ijuk palm saray with polyester has flexural strength avarage 32.10^3 MPa and impact strangth avarage 5300 J/m^2 which similar to a material used on bumper car [22-23].

CONCLUSIONS

Ijuk palam saray has been a good composite with polyester mainly after treated with a solution of NaOH 5% for 2 and 3 hours at volume fraction 2%.

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