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The Effect of Gel Coat Layer Composition on Bending Strength of Kenaf Fiber Reinforced Polymer

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Abstract. This research was a report of the effects of the gel coat against bending stress kenaf fiber composite/polyester before and after immersed in sea water. The research method that was applied in this study is by immersing the test specimen using a composite absorption for 1 to 6 months followed by bending test. The results were compared between the gel coat code K1, K2, K3, K4 and K5. The results showed that the most excellent bending stress was containing gel coat 0:35 Reolosil QS-102 kg with 10 kg of resin SHCP 268BQTN (K2) with the value of the bending stress is 19.98 MPa after immersed for 6 months. Bending stress before immersed is 43.1299 MPa, imply that it was decreased by approximately 53.6%, compared with other compositions that decrease to 54.1% (K3). The effect of the composite surface before and after immersed was analyzed by Scanning Electron Microscopy (SEM).

1. Introduction

Kenaf Fibres derived from fiber tree called kenaf tree (Fig. 1) or in the Latin is named Hibiscus cannabinus Lynn. It is a species of plant origin from African countries [1-5]. Kenaf is widely cultivated for jute sacks of raw materials, raw materials and textile yarn fabrics, even for a car bumper beams [6-8]. Kenaf Fibres have been widely cultivated in several countries in the world such as Indi a, Bangladesh, Thailand, parts of Africa, southeast Europe and Malaysia [9]. In Malaysia, the government through the National Research and Development Program of the National Kenaf, allocating funds starting in 2006 - 2010 with amount of RM 12 million for industrial purposes such as kenaf-based applications for automotive products, food packaging, furniture and sports equipment [10]. Currently there is a demand for these fibers used as reinforcement for the polymer [11]. One thing is a shortage of kenaf fibres to water absorption is very large [12]. From this reason that in this study the manufacture of composite with kenaf fibres coated with a gel coat surface to reduce water absorption. This research is started to use kenaf fibre composites / polyester products used for applications in aqueous media.

There are many studies that examine the kenaf fibre strength. Shinichi et al [13] developed the biocomposite boards that are lighter and more resilient by using kenaf fibres in biaxial directions, and polypropylene fibres. . The elastic modulus is measured to determine the effect of the number of layers of kenaf and heating time. From these studies, it showed that the optimum weight fraction of kenaf showed maximum flexural modulus, decreases with the decrease in bulk density. Development of thermoplastic elastomer composites reinforced with 20 vol.% Kenaf fibres. Two types of effect modifier mixed with polypropylene (PP), namely; thermoplastic natural gums (TPNR) and polypropylene / ethylene-propylene-diene-monomer (PP / EPDM). The presence of kenaf fiber (KF) has significantly increased tensile strength / PP EPDM about 81% while only 55% of the increase achieved in

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TPNR-KF-Mapp compared with TPNR principle without reinforcement. In addition, the flexural strength and excellent impact strength.

Figure 1. Tree Kenaf (Hibiscus cannabinus Lynn)

2. Research methodology

2.1 Materials and specimens preparation.

The used Polyester material is divided into two parts, one is used to make the gel coat and the other is used for the manufacture of composite kenaf fibres.

The used Kenaf Fibres has a density value of 56.68 kg / m3 with Randomly oriented discontinuous fibre types. This type of composite short fibers are scattered at random among the array of rows and columns (matrix). To create a composite with kenaf fibers used polyester resins (Highpolymer Chemical Products Singapore Pte Ltd) types SHCP 268BQTN. Especially for create a gel coat used Reolosil QS-102 and Resin SHCP 268BQTN with a specific composition. In this study used five types of gel coat with different compositions as shown in Table 1. Reolosil used is a product of Huaqiang FRP International Trading Co., Ltd. With a density value of 50 g / Ltr. The specimen surface is coated with a gel coat thickness of 0.5 to 0.6 mm in order to protect the surface from water penetration. Results of this study as the materials that will be applied to the product engineering materials that are used in sea water as boats and for others purposes.

Table 1: Mixed content gel coat and resin SHCP 268BQTN 10 kg

No.	code	Reolosil QS-102
1	K1	0.35
2	K2	0.3
3	K3	0.25
4	K4	0.2
5	K5	0.175

2.2 Flexural strength test

Flexural strength is the highest voltage experienced in the materials at the point of rupture. Tensile strength test specimens prepared in accordance with ASTM D790 [15]. The specimen is placed in between two pedestal in the range of 65 mm. Bending test performed using a model 4486 Instron machine with a maximum load of 100 KN. Speed suppression of flexure testing machine is 2.0 mm / min.

2.3 Absorption Test.

Absorption test aims to determine the percentages of water absorption during immersed in water. Water used in this study is that sea water with PH 7:05. Immersion the specimen is done in stages starting at 1 month, 3 months and 6 months. Absorption test is done using standard specimens. ASTM D570 with a length of 76.2 mm, 25.4 mm wide and 3.2 mm thick (Fig 2). After immersion and then drying in a drying oven to keep the temperature constant at 30ºC. To determine the weight percentage of water absorption in the specimen, weighing done well before the specimen immersed.

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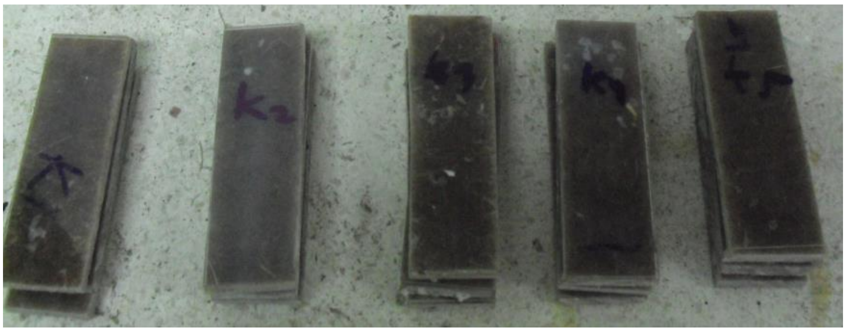
Figure 2. The shape of the absorption of the test specimen

2.4 Morphological tests

Morphological tests of the specimens were performed using Scanning Electron Microscope (SEM, JEOL JSM 6390 LV type) to view the microstructure of the specimens before immersion and after immersion. The Specimen to be investigated are the properties of micro-structure of a given layer of titanium which then inserted into the machine auto fine coater JFC 1600 for 1 hour until the correct coating level of all surfaces has been investigated. After all surfaces are coated with titanum and then the specimen is ready to be investigated on the testing machine of SEM. After all surfaces are coated with titanum then the specimen is ready to be investigated using SEM.

3. Results and Discussion

Table 2: Strength of the maximum bending composite kenaf fiber / polyester gel coat composition of 5 immersed in sea water.

Kod	Immersion time (month)							
	0		1		3		6	
	σ (MPa)	μ(mm)	σ (MPa)	μ(mm)	σ (MPa)	μ(mm)	σ (MPa)	μ(mm)
K1	43.13	2.00	31.26	1.47	17.39	1.44	16.68	1.33
K2	47.73	2.00	32.26	2.00	24.08	1.65	23.42	1.29
K3	42.54	2.22	26.19	1.59	21.62	1.72	19.75	1.40
K4	41.37	1.14	27.91	1.69	20.29	1.42	17.33	1.50
K5	41.90	1.88	23.79	1.60	20.44	1.62	19.28	1.34

From table 2 it can be seen that the value of percentage decrease in flexural strength, K2 is a mixture of gel coat composition of the best of the entire composition of the mixture because K2 has the smallest drop in stress strength up to 6 months of immersion. which only amounted to 50.94% when K3, K5, K4 and K1 respectively is 53.57% decrease in percentages, 53.98%, 58.11%, 61.32%. Before immersion K2 value is 47.73 MPa and after immersion for 6 months flexural strength values K2 is 23:42 MPa.

From Fig. 3 can be seen that the results obtained change between the decrease in flexural strength began immersion 1 month to 6 months for all compositions between K1, K2, K3 K4 and K5. This happens because of the presence of molecules of salt in sea water (particularly sodium chloride) can accelerate the spread of water absorbed in the composite material, therefore, the specimen absorb a higher water content. Besides that it can be seen from the graph that the impression of the gel coat composition does not significantly affect the results that obtained for flexural strength.

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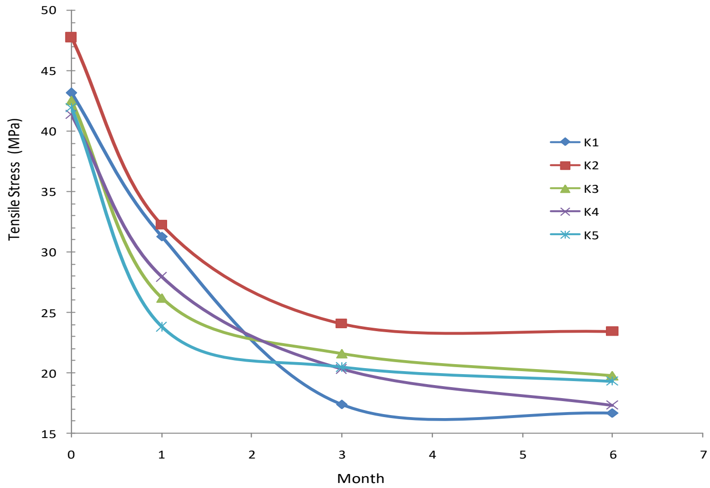
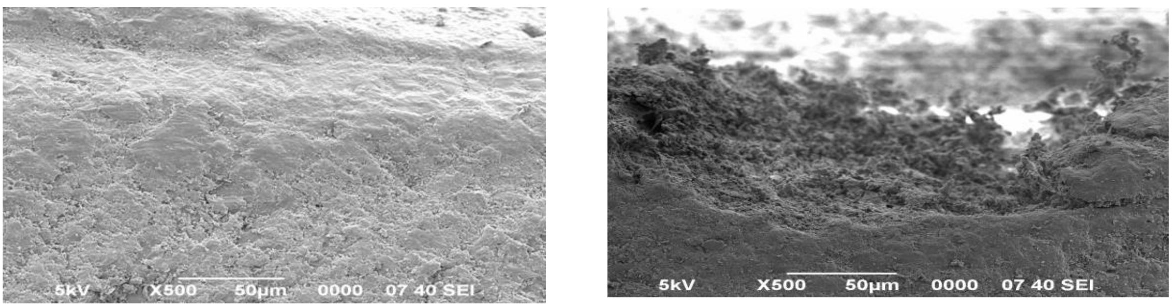


Figure 3. Differences decrease the maximum bending stress for K1 to K5 composite kenaf fiber / polyester before and after immersion in sea water for 6 months

Physically used kenaf fiber is very homogeneous but because kenaf fibers are cellulose, it creates a kenaf fiber that becomes stronger because cellulose is not strong enough to pull the OH hydroxyl groups present in the polyester ester compound. Nevertheless it can be seen that the percentage of stage K2 has the smallest decrease in flexural strength compared to the gel coat composition to another.

In addition, when viewed from the aspect of flexural strength it decrease as shown in figure 3 that the very large reduction in bending strength after immersion valid for a month. It is thus a paddock kenaf fiber is a cellulose fiber which when mixed with the ester compound is not very strong bond OH hydroxyl groups because compounds similar to cellulose ester compound. In theory if the same compound, the smaller reacting hydrogen bonds formed [14] .This will cause a weakness on kenaf fiber composites thus when immersed in water molecules it would easily fit that can lead to reducing the fiber strength. After the kenaf fiber reaches saturation stage, power will decline gradually as of immersion at 1 month to 3 months and to 6 months. It can also be proved by looking at the observations in Scanning Electron Microscopy as in figure 4a. And 4b and absorption of the test results.

In the absorption testing it can be obtained results as shown in Table 3. In Figure 6 it can be seen that in general for all concentration, gel coat on kenaf fiber composite specimen / polyester is increased in the increased percentage in weight before immersed up after immersion for 6 months at sea.



(a) (b)

Figure 4. (a). SEM results kenaf fiber composites before immersion in sea water, (b) SEM Results kenaf fiber composites after immersion in seawater

From Table 3 and Figure 5, it shows that the percentage increase in weight of K2 is smaller than the value of the overall increase in weight of the gel coat other concentrations. Starting from the prior immersed upto soaked for 6 months. After soaking one month, the percentage of gain K2 is 0.006%,

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while after soaking 6 months worth of percentages of weight gain K2 immersion becomes 0.040%. where the percentage increase in weight of the gel coat composition to the other until immersion of 6 months each K1, K3, K4 and K5 is 0.051%, 0.0501%, 0.050% and 0.050%.

Table 3: percentages of weight gain specimen composite gentian kenaf / polyester gel coat composition of 5 immersed in the sea

code	Month (%)		
	1	3	6
K1	0.011	0.046	0.051
K2	0.006	0.030	0.040
K3	0.015	0.033	0.051
K4	0.012	0.043	0.050
K5	0.016	0.036	0.050

In general, the enactment of the percentage increase in weight which caused by immersion that creates a composite gradually cracked and broken, Transportation water molecules through micro cracks become active. Water molecules are actively attacking the face, causing debonding of the fiber and the matrix [14]..

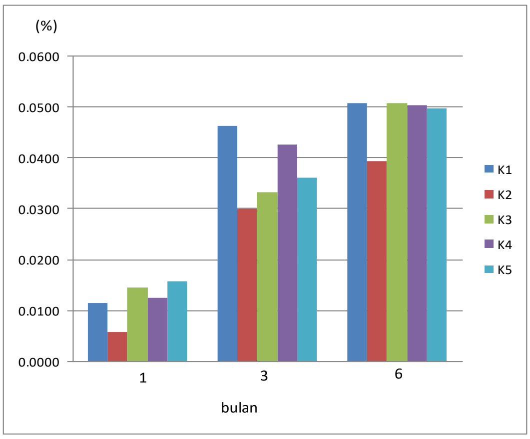

Figure 5. Differences percentage weight increase due to immersion water to the composition of the K1 to K5 composite kenaf fiber / polyester soaked in sea water after being soaked up to 6 months.

4. Conclusion and Discussion

Effect of the concentration of gel coat on the surface of the composite after immersion ranging from 1 month to 6 months will affect the mechanical properties such as flexural strength. It can be seen that the longer the immersion, the bending strength of the composite material kenaf fiber / polyester that was declining even from month 3 to month 6 was not too significant. The best Intensity flexural strength obtained on the composition of the gel coat with code 2 (K2 compared Reolosil QS 102: Resin SHCP 268BQTN was 0.3 kg: 10 kg). However, the effect of the gel coat is not too significant for the difference in flexural strength whether before immersion or after immersion. This is an evident from the results of the tests in which the values of the percentage decrease in the flexural strength is not too much difference between the composition of the K1, K2, K3, K4 and K5.

Decrease in flexural strength is directly proportional to the high absorption of the composite during immersion, the longer absorption that occurs then the flexural strength of specimens decreased too. It is influenced by the swelling surface through saturated saturation, resulting in damage to the surface and causing pervasive water in the composite structure.

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References

[1] J. A. M. Mohd Edeerozey, Hazizan Md Akil, A.B. Azhar, M.I. Zainal Ariffin, Chemical modification of kenaf fibers. Materials Letters. 61 (2007) 2023 - 2025.

[2] C.I. Ogbonnaya , H. Roy-Macauley, M.C. Nwalozie , D. J.M. Annerose, Physical and histochemical properties of kenaf (Hibiscus cannabinus L.) grown under water deficit on a sandy soil. Industrial Crops and Products. 7 (2007) 9-18.

[3] N. R. Gita , S. Bambang, R. B. Catherine, Brian S. Baldwin , *Frost kill and kenaf fiber quality* Industrial Crops and Products. 19 (1999) 189 - 195.

[4] Hongqin Yu , Chongwen Yu, *Study on microbe retting of kenaf fiber.* Enzyme and Microbial Technology. 40 (2007) 1806 - 1809.

[5] J.J. Lips Steef, Goretti M. In˜ iguez de Heredia, G.M.Richard , Jan E.G. van Dam, *Water absorption characteristics of kenaf core to use as animal bedding material.* industrial crops and products. 29 (2009) 73 - 79.

[6] Sastrosupadi Adji , Santoso Budi, Sudjidro, *Cultivation of Kenaf (Hisbiscus cannabinus L.)*, M. Balittas (2004) 1 – 14.

[7] Sudjindro, Opportunities and Challenges of Natural Fiber Utilization of plants as raw materials in Indonesian Textiles, M. Balittas. (2004) 1 - 11.

[8] M.M. Davoodi, S.M. Sapuan, D. Ahmad, Aidy Ali, A. Khalina, Mehdi Jonoobi, Mechanical properties of hybrid kenaf/glass reinforced epoxy composite for passenger car bumper beam, Material and Design. 31 (2010) 4927- 4923.

[9] C.W. Chin, B.F. Yousif, Potential of kenaf fibres as reinforcement for tribological applications, Wear. 267 (2009) 1550–1557.

[10] S. Rassmann, R.G. Reid , R. Paskaramoorthy, Effects of processing conditions on the mechanical and water absorption properties of resin transfer moulded kenaf fibre reinforced polyester composite laminates, composite :Part A. 41 (2010) 1612 – 1619.

[11] T. Nishino, K. Hirao, M. Kotera, K. Nakamae, H. Inagaki, *Kenaf reinforced biodegradable composite,* Composites Science and Technology. 63 (2003) 1281–1286.

[12] S. Rassmann, R.G. Reid , R. Paskaramoorthy, Effects of processing conditions on the mechanical and water absorption properties of resin transfer moulded kenaf fibre reinforced polyester composite laminates, Composites: Part A. 41 (2010) 1612–1619.

[13] S. Shinichi , C. Yong , F. Isao , Lightweight laminate composites made from kenaf and polypropylene fibres. Polymer Testing. 25 (2006) 142 - 148.

[14] H. Anuar, A. Zuraida, Improvement in mechanical properties of reinforced thermoplastic elastomer composite with kenaf bast fibre. Composites: Part B. 42 (2011) 462 – 465.