Mechanical Strength of Petung Bamboo (Dendrocalamus Asper) Strip

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Mechanical Strength of Petung Bamboo ((*Dendrocalamus Asper*) Strip Woven Composite with Epoxy Resin Matrix

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Abstract

Bamboo is one of the natural materials which has a good prospect for reinforcement of composite material. It is quite abundant in Tana Toraja South Sulawesi Province - Indonesia. The purpose of this study is to analyze the pretreatment effect on the tensile strength of the bamboo strip woven composite. The tensile testing based on ASTM D 638-02 standard was conducted to analyze the tensile strength of the bamboo strip woven composite. The results showed that the duration of immersion time of the bamboo strip woven for 1 day, 2 days and 3 days affected the tensile strength of the bamboo strip woven composite. In the treatment of the water sulfur immersion, the tensile strengths of the composite increases with the duration of immersion time for 1 day, 2 days and 3 days are 89.70 MPa, 125.44 MPa, and 159.01 MPa respectively. While the soaking treatment of water sulfur and continued to the seawater immersion treatment with the variation of the immersion time of 1 day, 2 days, and 3 days, the tensile strengths are 95,92 MPa, 130,69 MPa, and 165,03 MPa respectively. Then, the tensile strains of bamboo strips woven composite with the immersion of sulfur water and without immersion of sea water (WISW) of bamboo strips woven for 1 day, 2 days and 3 days are 1.58%, 2.00%, and 2.86 % respectively. While the immersion of water sulfur and continued on the immersion of the seawater (ISW) with the variation of immersion time of 1 day, 2 days, and 3 days are 1.65%, 2.60%, and 3.09% respectively.

Keywords: Woven bamboo strips, sulfur water, sea water, tensile strength

INTRODUCTION

Natural fibers are still unfamiliar for Indonesian people for more applications and generally are useless materials. But with advances in engineering technology, composite materials have made a significant progress in material development, especially the application in the manufacturing industry. The engineering technology and innovation of such composite materials is one of the uses of natural materials as a composite reinforcing material. Bamboo is a natural material which has a good prospect for to be used as reinforcement of the composite material. Bamboo is the name of a collection of wood-shaped grasses or curved shrubs, with stems that are usually erect sometimes uphill, woody and branched, can reach longevity and usually die without flowers. It has many types in its availability in Indonesia and is abundant. One of which is petung bamboo in Tana Toraja - South Sulawesi Province.

Bamboo is an important biological resources, because of not only their enormous potential, but also its high utilization rates such as for household utensils, handicrafts, foodstuffs, construction materials, and so on [1] . In terms of physical and mechanical properties, betung bamboo (Dendrocalamus asper) is a potential structural component for building materials, furniture materials, household purposes, and for simple housings. Damon still does not land against destructive pests, such as wood powder dry [2,3]. It has a great opportunity as an alternative raw material for producing composite because it has many advantages like fast growing, economical/inexpensive, renewable, and abundant all over the world. It has also an excellent physical and mechanical properties and can be compared with commercial wood species.

In the composite materials, the interfacial strength of fiber-matrix is strongly influenced by the adhesion ability of the fibers and the matrix. This adhesive ability is very important to ensure the strength of composites, because the adhesion between fibers with low mats can lead to fiber pulling and shifting. This induces the certainly reducing the strength of the composite. Then, the epoxy resin matrix used as fiber adhesive and belonging to a group of high strength, has a good resistance to environmental degradation consequently this resin has been widely used in aircraft industry. Beside that, epoxy resin properties are also a good adhesive and

resistant to water degradation so that this resin is ideal for use as boat body or ship [4]. The purpose of this research is to analyze the effect of the long period of immersion of bamboo strip woven (Dendrocalamus Asper) to the tensile strength of sulfur water and seawater with epoxy resin matrix.

RESEARCH METHODS

Materials

Bamboo (Dendrocalamus Asper) as a booster is obtained from Lembang Tokesan area, Sangalla District, Tana Toraja District, South Sulawesi Province. Bamboo strips were made with a thickness of 1 mm and then were made the woven (250 mm x 250 mm). The woven bamboos were soaked into the sulfur water for 1 day, 2 days and 3 days and without immersion treatment. The immersion of the woven bamboos in the water bath of sulfur was conducted at Makula, Lembang Tokesan, Sangalla District, Tana Toraja District, South Sulawesi Province. Epoxy resin was used as a matrix with the ratio of resin and hardener 60:40. Epoxy resin was obtained from PT. Justus Kimia Raya, Semarang branch

Treatment Process of Bamboo Woven Strip

Before treatment process, bamboos were made into bamboo strips with 1 mm thickness and 250 mm length. Bamboo strips were then made the bamboo strip woven with 250 mm x 250 mm size. Then, this bamboo strip was weighed to know the moisture content before soaking in sulfur water. This bamboo strip woven was treated with the variation of the immersion time for 1 day, 2 days, and 3 days. After immersion of water sulfur with the variation of time there was a subsequent treatment at the seawater immersion with the variation of time for 1 day, 2 days, and 3 days [5].

Manufacturing Process of Composite Panel

Bamboo strip composite was manufactured by using the steel plate mould with 250 mm x 250 mm size-Steps of the composite panel manufacturing process were: The first step was to pour the resin and hardener in accordance with the predetermined ratio into the measuring cup and mix the resin and hardener in a container and stir the mixture evenly; secondly, pour the resin mixture and hardener into the mold sufficiently; then, flatten until all the molded areas are filled after it inserts the bamboo strip woven into the mold and pour back the resin and hardener mix. The three ply bamboo strip wovens were used for manufacturing of composite. Steel plate molding was then pressed with a hydraulic press to obtained.The expected thickness of the composite according to the standard. Composite was released from moulding during 6-8 hours. Then, the composite panel was taped to the paper which has been drawn the tensile specimens according to the ASTM standard (width, length and thickness have been appropriate). It was cut by using the saw machine following the shape of the tensile specimen image. After the cutting of specimens, the specimens finishing was done by using miser and fine sandpaper to obtain more smooth and evenly of the outer surface of specimen. The specimen was ready to tested.

Composite Tensile Testing Process

The dimensions of tensile testing composite specimens according to standard ASTM D638-02 type I, Width of narrow section (W = 13 ± 0 .5) mm, Length of narrow section (L = 57 ± 0,5) mm, Width overalls, min (Wo = 19 ± 6.4) mm, Length overall, min (Lo = 165) mm, Gage Length (G = 50 ± 0.25) mm, Distance Between Grips (D = 115 ± 5) mm, Radius of fillet (R = 76 ± 10 mm, and Thickness (T) according to the thickness of the test material. The number of tensile testing specimens is 8 (eight) pieces. The Go Tech Universal Testing Machine Tensile Test Equipment Model KT-7010A2, capacity 1000 Kg, production Kao Tieh Machinery industrial CO., LTD, 1995 was used in this study. Tensile testing speed is 4 mm/min.

Figure 1. Go Tech Universal Testing Machine

The steps for tensile testing of specimens are; (1) measuring the dimensions of specimens include the length, width and thickness; (2) labeling of serial numbers and bamboo strip woven composites on each specimen after measuring to avoid recording errors; (3) turn on Geo-Tech universal machine for tensile testing; (4) installation of test specimens on the tap part of the tensile test machine; (5) attaching it carefully to the testing specimen perpendicularly, then tighten it so that the specimen does not slip on the holder but do not excessive tightening to avoid the damage specimens; (6) attaching the elongation pointer to the line length of the narrow section; (7) then, specify the load used in the test and the speed, with selecting a constant speed of 4 mm/min with a loading of P = 1000 kg. After the engine was run, we observe the indicator load and the indicator elongation on the test machine until specimen breaks. The machine was automatically recorded stress-strain curves on the graph paper. After the tensile testing, the data result was continued to calculate and analyze the tensile strength.

RESULTS AND DISCUSSION

Tensile Strength of Bamboo Strip Woven Composite

Tensile testing of bamboo strip woven composite is intended to find out the mechanical strength (i.e. tensile strength) the bamboo (*Dendrocalamus Asper*) strip woven composite is shown as in Fig. 2.

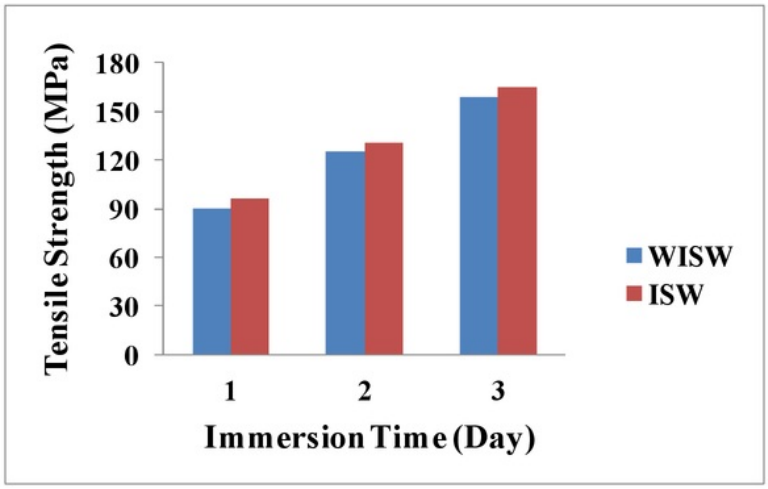

Figure 2. Tensile strength of bamboo strip woven composite with the variation of the immersion time

Figure 2 shows that the tensile strengths of the bamboo strip woven composite with soaking the bamboo strip woven in sulfur water and without seawater treatment (WISW) with the variations of immersion time 1 day, 2

days, and 3 days are 89.70 MPa, 125.44 MPa, and 159.01 MPa respectively. Meanwhile, the sulfur water immersion and continued seawater immersion (ISW) with the immersion time variation of 1 day, 2 days, and 3 days are 95.92 MPa, 130.69 MPa, and 165.03 MPa respectively. From both immersion, it can be said that the tensile strength of composite with soaking bamboo strip woven in sulfur water (WISW) is smaller than the subsequent immersion in seawater (ISW). The result of soaking on sulfur water then continued soaking of sea water gives the effect of increasing the mechanical properties (i.e. tensile strength) of the bamboo strip woven composite.

The above results are consistent with several studies previously on bamboo strip woven composites. The mechanical properties of bamboo strip composites with the polyester matrix with the variations of the arrangement of strips were obtained the highest stresses occurring in elongated fiber structure [6]. Related to compressive strength and flexural material of the bamboo fiber reinforced epoxy composite, the materials used are betung bamboo as reinforecement and borax, boric acid and aquades as solvents for treatment. The result is preservative chemicals increasing the tensile strength of bamboo [7] . The utilization of bamboo material as an alternative composite material for wooden ships replacement wood material showed that radial and tangential irradiation direction to bamboo fiber did not significantly affect the strength of composite material (BRP). Factors that significantly influence the strength of BRP composite materials are bamboo and fiber variations (plaited, unplaited and random fibers) [8] .

Tensile Strain of Bamboo Strip Woven Composite

The tensile strain property of bamboo strip woven composite on the duration of immersion time is shown as in Fig. 3.

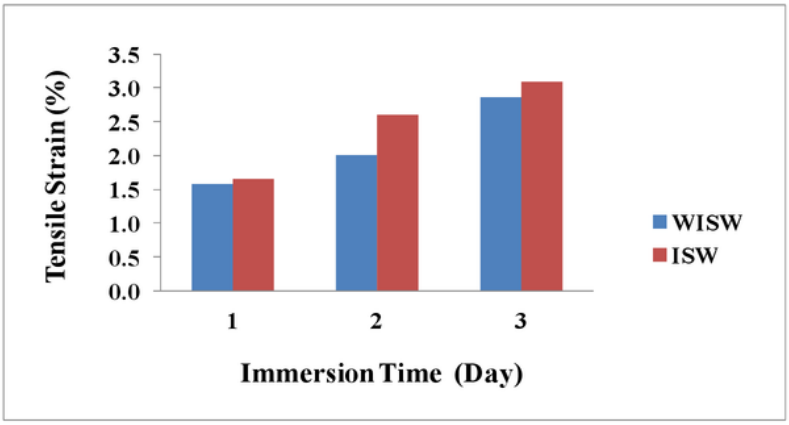

Figure 3. Tensile strain of bamboo strip woven composite with the variation of the immersion time

In Figure 3 shows the relationship between the tensile strain and the duration of immersion of bamboo strip woven composite. The tensile strains of the bamboo strip woven composite with soaking bamboo strip woven in the water sulfur and without immersion of the seawater (WISW) with the variation of immersion time 1 day, 2 days, and 3 days are 1.58%, 2.00%, and 2.86%. While soaking sulfur water and continued on the seawater immersion (ISW) with variation of immersion time 1 day, 2 days, and 3 days are 1.65%, 2.60%, and 3.09% respectively. If compared to treatment of WISW with ISW according to immersion time hence increase of tensile strain strength obtained for 1 day, 2 days and 3 days respectively equal to 4%, 23% and 7% whereas if referenced with value of tensile strain strength of smallest tensile then obtained by 4%, 39%, and 49%.

CONCLUSION

The duration of immersion time affects the tensile strength and tensile strain of the bamboo strip woven composite. In the treatment of water sulfur immersion, the tensile strength increases with the variation of the duration of immersion 1 day, 2 days, and 3 days i.e. 89.70 MPa, 125.44 MPa, and 159.01 MPa respectively. While the treatment of sulfur water immersion and continued to the treatment of soaking seawater with variation of time immersion time of 1 day, 2 days , and 3 days obtained that is 95.92 MPa, 130.69 MPa, and

165.03 MPa respectively. While the tensile strains of bamboo strip woven composite with soaking bamboo strip woven in the immersion of sulfur water and without immersion of the seawater (WISW) with variation of immersion time 1 day, 2 days, and 3 days are 1.58%, 2.00%, and 2.86%. While soaking sulfur water and continued on immersion of sea water (ISW) with variation of immersion time 1 day, 2 days, and 3 days are 1.65%, 2.60%, and 3.09% respectively.

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