

TENSILE STRENGTH ANALYSIS OF COMPOSITE REINFORCED *PETUNG* BAMBOO WOVEN (*DENDROCALAMUS ASPER*)

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ABSTRACT

This study aims to analyze the tensile strength and changes in the micro structure of epoxy resin composite reinforced petung bamboo strip woven (Dendrocalamus asper). The material used in this studied is the type of petung bamboo Petung bamboo is cut in strips with a length of 30 cm and a thickness of 1 mm, then woven. Woven bamboo strips immersed in water with varying levels of salinity (10, 20, and 30%) and variations in immersion time 2, 4, 6, and 8 weeks. Immersion bamboo strips are used as composite reinforcement. Epoxy resin is used as a matrix. Composites are molded by varying the number of layers of woven bamboo strips, respectively 1, 2, and 3 layers. Tensile testing is carried out with reference to ASTM 638-02 standard. From the results of the study, it was found that the effect of immersion time and salinity level significantly affected the tensile strength of composites reinforced by woven petung bamboo strips. The highest tensile strength occurs in the reinforcement of petung bamboo strip 3 lays and level of salinity 10%, with an immersion time of 2 weeks of 65.479 MPa. The lowest tensile strength occurs at immersion time 8 weeks value of 49.421 MPa.

KEYWORDS: *Petung Bamboo, Dendrocalamus Asper, Epoxy Resin, Tensile Strength & ASTM 638-02 Standard*

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INTRODUCTION

Composite is an engineered material consisting of two or more types of material that are chemically and materially different, (Attaf, 2011; Bai, 2003; Fazeli, Florez, & Simão, 2019; Miracle et al., 2001). Composite base ingredients can be made of metal or natural materials. Natural material is one that has been developed as an alternative material to replace synthetic materials due to considerations of cost and good mechanical strength, (Aditya, Kishore, & Prasad, 2017; Tesinova, 2011). The natural material currently being developed for composite reinforcing materials is bamboo. This is sought by material engineers because of its abundant availability in various countries and its growth is also relatively fast. The reason for using bamboo as a composite reinforcement is because bamboo has a low density, mechanical strength and high rigidity, (Fatriasari, Damayanti, & Anita, 2013; Sastry, Janssen, Boughton, Adkoli, & Ranjan, 1991). Various types of bamboo can be used as a composite reinforcement. In this study selected types of petung bamboo (*Dendrocalamus asper*) because of its good mechanical properties, but this type of bamboo has a weakness that is easily eaten by insects, namely termites, (Kannan & Ahmad, 2013; Rassiah, Ahmad, Ali, & Nagapan, 2018; Trujillo De Los Ríos, 2014). The purpose of this study was to make composite reinforced petung bamboo strips both treated and normal. The treatment is expected to increase the tensile strength and changes in the microstructure, especially on the strip surface. Immersion treatment of woven strips in water media with time

variations of 2, 4, 6, and 8 weeks and the salinity of immersion water 10, 20, and 30 %. Selection of bamboo strip immersion with water because the chemical elements of bamboo and water can be well compounded so as to increase the strength of strips woven to strengthen epoxy resin composites.

MATERIALS AND METHODS

The material used in this studied, namely petung bamboo Figure 1a. Petung bamboo was cut 30 cm long and made in strips-shaped 1 mm thick, Figure 1b. After that, it is weave into woven bamboo strips Figure 1c. Bamboo strips woven are immersed in water with salinity levels of 10, 20, and 30 %, as shown in Figure 2a. The level of salinity is measured using the Salinity measuring instrument (Refractometer Master) Figure 2b.

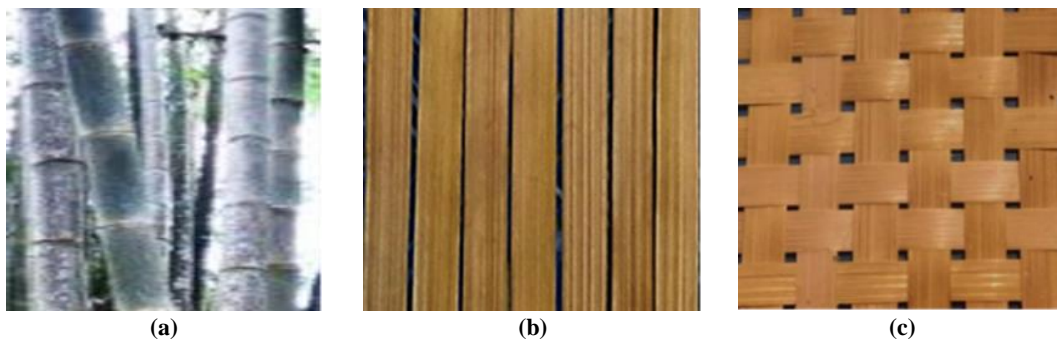


Figure 1: *Petung* bamboo; (a) bamboo trees, (b) bamboo strips, (c) woven bamboo strips

Immersion time implemented with variations 2, 4, 6, and 8 weeks. After the immersion process, the woven strip is removed from the container and then dried with sunlight Figure 3a. The process of making composite panels using the method of hand lay-up with pressurized molding Figure 3b. The composite material consists of epoxy resin with reinforcement made of woven bamboo strips with variations in layers 1, 2, and 3 lays as shown as in Figure 3c.

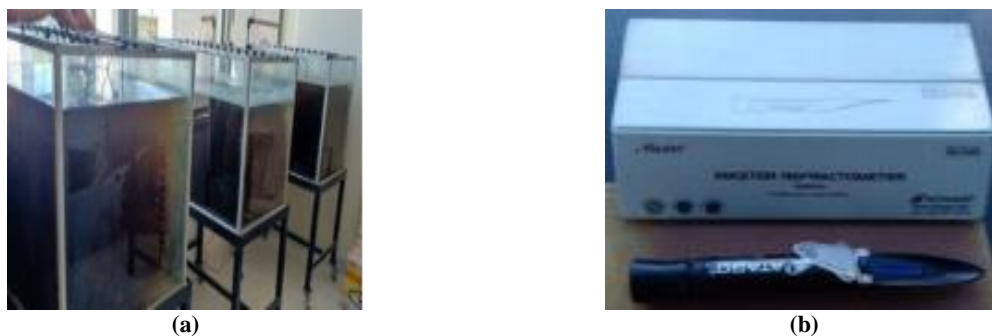


Figure 2: (a) woven immersion strips container, (b) salinity measuring instrument (refractometer master)

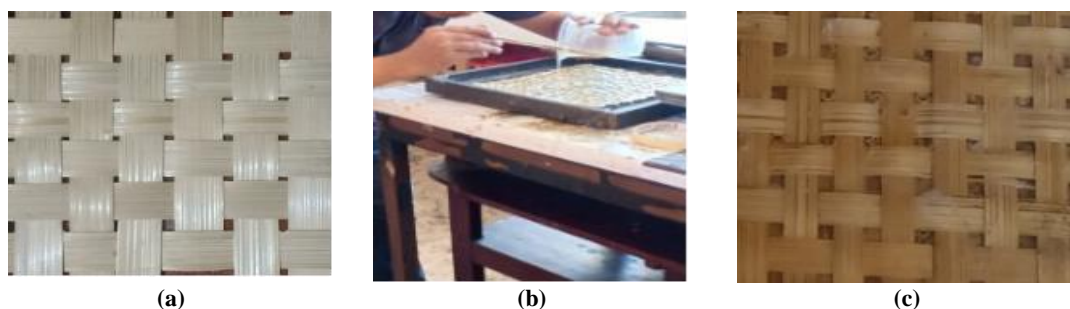


Figure 3: (a) Woven strips after immersion, (b) Composite manufacturing process, (c) Composites

Tensile test specimens prepared according to ASTM 638-02 standard, as shown as Figure 4.

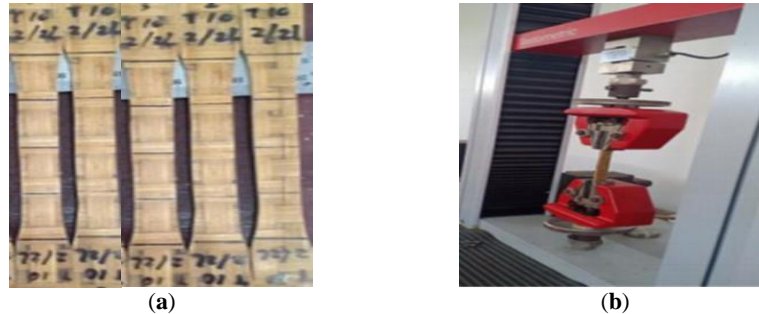


Figure 4: (a) Tensile test specimen, ASTM 638-02, (b) Tensile test equipment

RESULTS AND DISCUSSION

The Figure 5-7 show that the effect of variations in the immersion time and water salinity (WS) on the tensile strength of composite reinforcement of petung bamboo strip woven epoxy resins (PBSW) is quite significant although still fluctuating. In Figure 5 shows, the highest composite tensile strength in levels of salinity 10 % is 3 (three) layers with immersion time 2 weeks of 65.479 MPa, and the lowest at immersion time 8 weeks of 53,504 MPa. Tensile strength is seen to increase until the immersion time 2 weeks and then decreases in the next week. This is because the compound between woven petung bamboo strips with water level of salinity 10 % is saturated until the immersion time is 2 weeks, then the immersion time is no longer useful for tensile strength.

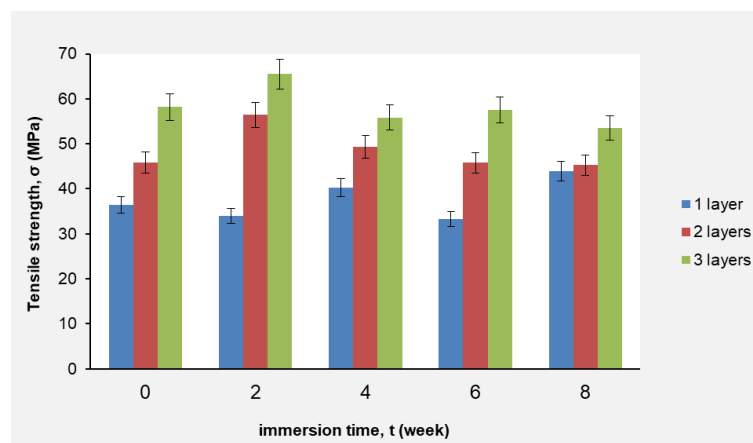


Figure 5: Correlation between tensile strength and immersion time at the salinity level of 10%

Figure 6 shows the highest tensile strength in submersion with level salinity of 20%. obtained is in the composition of 3 layers with 4 weeks immersion time with the highest tensile strength of 61.534 MPa, and the lowest at immersion time 8 weeks of 49.421 MPa. This shows that a significant increase in the tensile strength of the composite only occurs at an immersion time of 4 weeks. Composite strength of each component of the number of layers, seen varying and not influenced by the immersion time and the number of layers of bamboo strips woven.

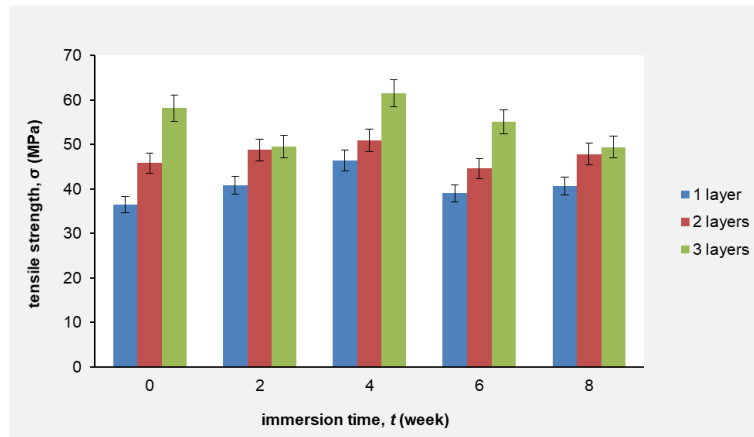


Figure 6: Correlation between tensile strength and immersion time at the salinity level of 20%

Figure 7 shows the highest tensile strength of the composite obtained is in the composition of 3 layers with 4 weeks immersion time with the highest tensile strength of 61.408 MPa, and 8 weeks of immersion at 50,879 MPa. This shows that a significant increase in the tensile strength of the composite only occurs at 4 weeks immersed with a water salinity of 20 %. Composite strength of each component of the number of layers, seen varying and not influenced by the immersion time and the number of layers of bamboo strips woven.

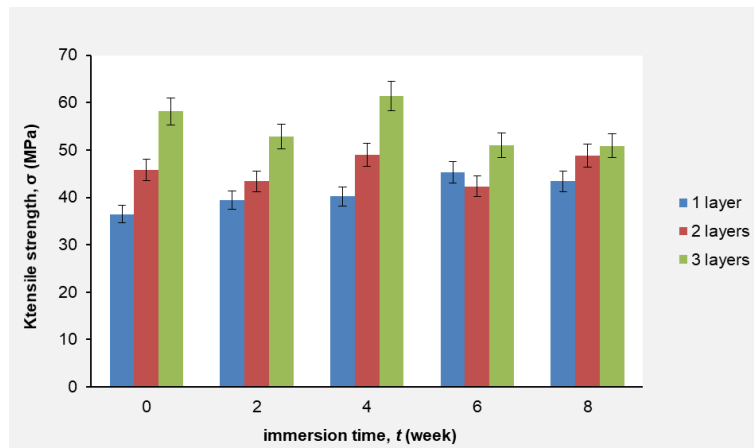


Figure 7: Correlation between tensile strength and immersion time at the salinity level of 30%

CONCLUSIONS

The composition of water salinity (WS) and variation of immersion time seen the tensile strength of composite epoxy resin reinforcement petung bamboo strip is woven (PBSW) still looks very volatile. The influence of immersion time and salinity water is quite significant on the tensile strength of composite epoxy resin reinforcement of petung bamboo strips woven occur at certain times of immersion and salinity, as described below:

- The highest tensile strength occurs in the reinforcement of petung bamboo strip 3 (three) layers and salinity 10%, i.e. 2 weeks immersion, the highest tensile strength is 65.479 MPa. The lowest tensile strength occurs at 8 weeks of immersion obtained values of 53.504 MPa.

- The highest tensile strength of composites obtained is in the composition of 3 (three) layers and salinity of 20%, i.e. the time of immersion 4 weeks obtained the highest tensile strength of 61.534 MPa. The lowest tensile strength occurs at 8 weeks immersion value of 49.421 MPa.
- The highest tensile strength of composites obtained is in the composition of 3 (three) layers and 30 30 salinity, which is a 4 week of immersion time with the highest tensile strength of 61.408 MPa. The lowest tensile strength occurs at 8 weeks immersion of 50.879 MPa.

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