Structural Integrity of laminated bamboo composites

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ABSTRACT

In this study, the fatigue and fracture properties of bamboo fiber composites with various woven layer were investigated. In these experiments, unsaturated polyester (UP) and bamboo fiber (BF) strips were prepared through the hand lay-up technique using 3 mm thick aluminium mould. The composite bamboo strips were prepared in 1.5 mm thickness. The strips are woven to make a single layer. The layer is then laminated into several thicknesses. The specimens were then characterized using fatigue and fracture tests. The fatigue limit of 30MPa and fracture toughness of 5-8 MPa $\sqrt{m}$ was obtained. These findings suggest that bamboo strips, based on unsaturated polyesters, provides relatively good in fatigue and fracture properties and a good alternative reinforcing fibers to combat fatigue and fracture failures.

Keywords: Unsaturated Polyester, Bamboo Strip, Gigantochloa Scortechinii, Fatigue and Fracture Laminated Composites.

INTRODUCTION

It is evident that natural fibers used for composite reinforcement are a subject of growing interest for many researchers, because of renewable and show excellent reinforcing properties for polymer composites [1, 2]. It was highlighted by Mohamed and Appanah [3], there is approximately 7.0 million tons (average 20 tons/ha) of bamboo stock in Malaysia, out of which, only 6,000 tons consist of commonly used species. This bamboo stock holds an estimated value of 3 million Malaysian Ringgit (RM). The composite material consists of cellulose fibers embedded in a lignin that is aligned along the length of the bamboo providing maximum tensile, flexural strength and rigidity in that direction [4, 5]. Recent studies on bamboo [6-9] successfully characterized the tensile, flexural, impact and hardness properties of bamboo composite comprehensively

The aim of this study is to characterize the fatigue and fracture properties of three different laminated bamboo strip composites of various thicknesses. The result of this research gives manufacturers and engineers a sound decision, whether or not to consider bamboo composite in their selection of materials in design processes.

RESULTS AND DISCUSSION

The fracture toughness was found to be 4.847 Mpa$\sqrt{}$ for the horizontal fibre orientation specimen and 8.334

Mpa√ for the vertical fibre orientation. There is no exact fatigue limit of the bamboo composite. The fatigue strength of bamboo composite with 30 MPa registers the highest in 1 x 10^6 cycles. The 3 mm thickness provides better fatigue resistance. The bamboo composites provides relatively good fatigue and fracture resistance among other composite

The exact fatigue limit is not observed as always clearly captured in steel fatigue test. The curve with no exact fatigue limit is following the Aluminum trend. The demarcation between low cycle fatigue (LCF) and high cycle fatigue (HCF) in cycles in bamboo composite can be suggested at the knee of the curve approximately at 1 x 10^4. It is worth to note that 3 mm thickness exhibit higher fatigue limit at 30 MPa, compared with 6 mm and 9 mm having fatigue limit of 20 MPa and 19 MPa respectively. In other work done by Drashil et. al, [21] the S-N curve of with different plant fibers/ yarns polester composites show similar trends. However the high-tech bamboo/epoxy composite made of Chinese Moso bamboo could reach 80 MPa fatigue limit as reported in [25].

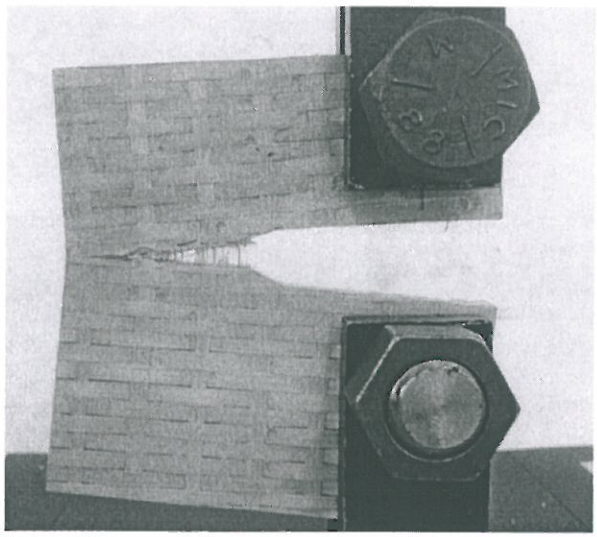

Fig. 1 Fracture Testing of Bamboo Composites

CONCLUSION

The fracture toughness was found to be 4.847 Mpa√ for the horizontal fibre orientation specimen and 8.334 Mpa√ for the vertical fibre orientation. There is no exact fatigue limit of the bamboo composite. The fatigue strength of bamboo composite with 30 MPa registers the highest in 1 x 10^6 cycles. The 3 mm thickness provides better fatigue resistance. The bamboo composites provides relatively good fatigue and fracture resistance among other composite

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