Analysis of Hybrid Natural Fiber Composite Material by Using Finite Element Analysis

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Abstract

In work represent the tensile static analysis of the hybrid laminated natural composite material with different cases and thickness. The static stress analysis includes the all type of stress, strain and deformation behavior in diagrammatic and tabulation form and results are good agreement with previous work. In the present work the modeling and analysis has been done in ANSYS APDL 16.2. On the other hand, the improvement in interest of using natural fibers as reinforcement in plastics to substitute conventional synthetic fibers in some automobile or other applications has become one of the main concerns to work the potential of using natural fibers as reinforcement for polymers. For this, present work has focused their attention on natural fiber composite which are composed of natural or synthetic resins, reinforced with natural fibers. In this work, which is clearly seen that the proposed work is more considerable work as compared to the later work. For improvement of later work the hybrid natural composite i.e. three natural fiber like palm, coconut coir and human hair are used, which is made good bound with each layer using epoxy resign and give the more expected result in present as compare to previous work. In future the work is to use this hybrid material which are most useful, biodegradable and safe.

Keywords: *Hybrid Natural Composite Material, Palm, Coir, Hair, ANSYS APDL.*

1. Introduction

Natural fiber polymer composites (NFPC) are a composite material consisting of a polymer matrix embedded with high-strength natural fibers, like jute, oil palm, sisal, kenaf, and flax [7]. Usually, polymers can be categorized into two categories, thermoplastics and thermosets. The structure of thermoplastic matrix materials consists of one or two dimensional molecular, so these polymers tend to make softer at a raised heat range and roll back their properties throughout cooling. On the other hand, thermosets polymer can be defined as highly cross-linked polymers which cured using only heat, or using heat and pressure, and/or light irradiation. This structure gives to thermoset polymer good properties such as high flexibility for tailoring desired ultimate properties, great strength, and modulus [2][3]. Thermoplastics widely used for bio fibers are polyethylene, polypropylene (PP) [8], and poly vinyl chloride (PVC); here as phenolic, polyester, and epoxy resins are mostly utilized thermosetting matrices [7]. Different factors can affect the characteristics and performance of NFPCs. The hydrophilic nature of the natural fiber [4] and the fiber loading also have impacts on the composite properties [9].

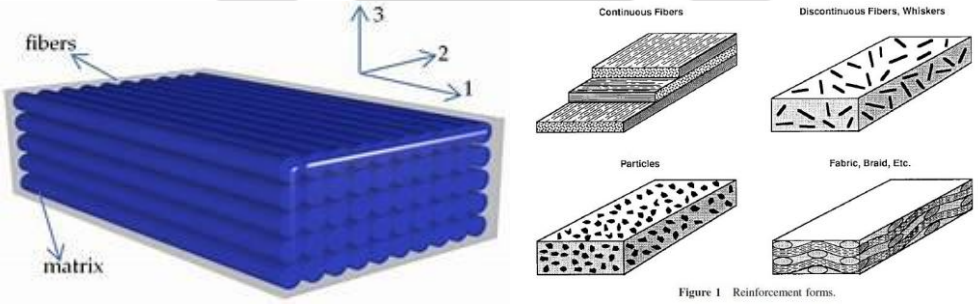


Fig 1. Composite material

1.1 Natural Fibers used in Work

(a) Palm Fiber: The palm tree stem is covered with a mesh made of single fibers. These fibers create a natural woven mat of crossed fibers of different diameters.

(b) Coconut Fiber: Coconut fiber, is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, brushes and mattresses.

(c) Hair Fiber: Hair has got excellent stiffness, tensile strength property and fairly good adhesive properties. Hair is capable of withstanding high loads, research has shown that a single strand of hair can withstand up to 125grams of load.

2. Problem Identification

From the study of various literature, the composite material was made, but mechanical properties not much enough. To rectify this problem, work have to decided made on the hybrid fiber using different natural fibers and its mechanical properties has been tested using experimental investigationthe composite materials have a higher strength than many other materials. Normally the good quality fibers having highest cost. Synthetic fibers are non-renewable fiber and the availability of the fiber was also difficult. Hence the naturally available Palm fiber, coconut fiber and human hair fiber were identified. These all fibers taken in this work are degradable.

3. Methodology

In this section, the discussed about the methodology apply in the work. In this work the finite element analysis APDL 16.2 has been used for static analysis of composite material. The dimensions of specimen for the composite materials has been selected from a reputed literature [7], and after some modification obtained results have been compared to literature [7] and discussed its improvement.

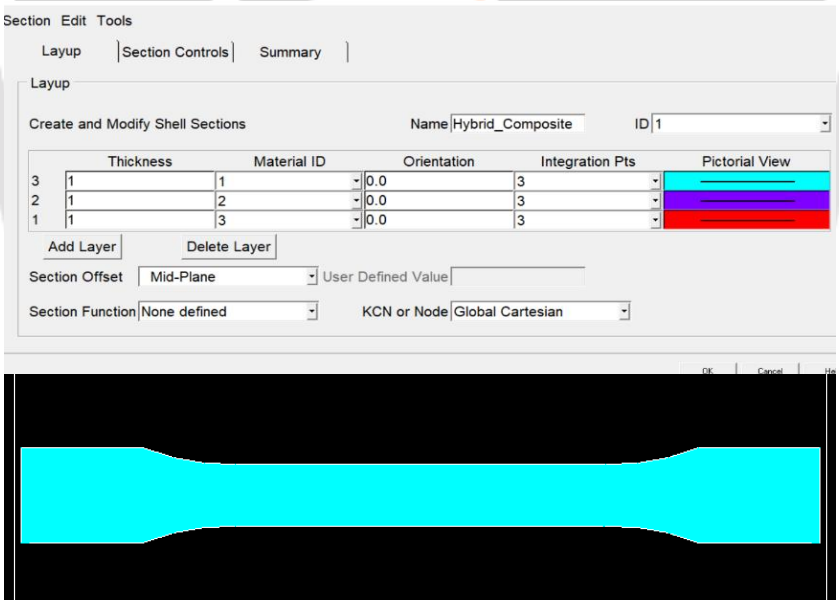
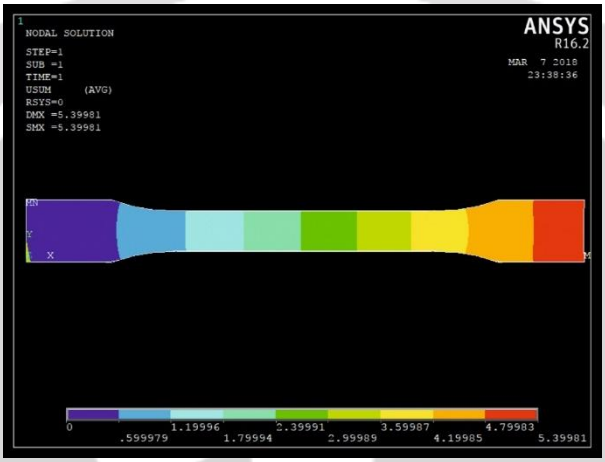


Fig 2. Model of composite specimen as per as ASTM standard (D638) [7]

(a)(b)



(c)

Fig 3. Contour plot of Case-I results (a) Strain, (b) Von-Mises Stress and (c) Deformation.

Further all results will be analyzed using same procedure, and results are obtained which are shown in next section.

4. Results and Discussions

An orthotropic plate with three numbers of layers is subject to longitudinal and transverse loading condition as per boundary condition has been considered for the present work, and the results were given in tabulated and diagrammatic/graphical form.

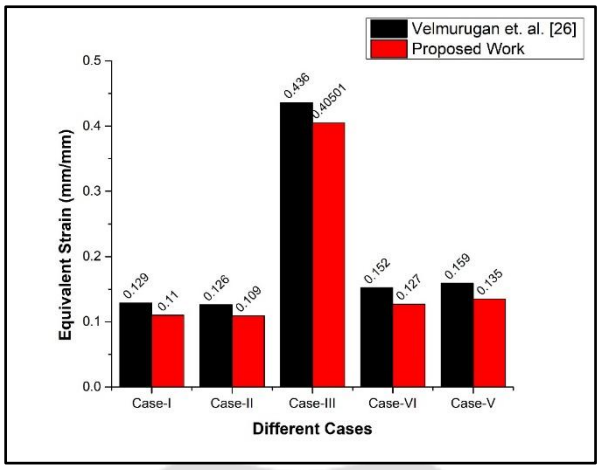


Fig 4. Graphical representation of equivalent strain between existing and proposed work

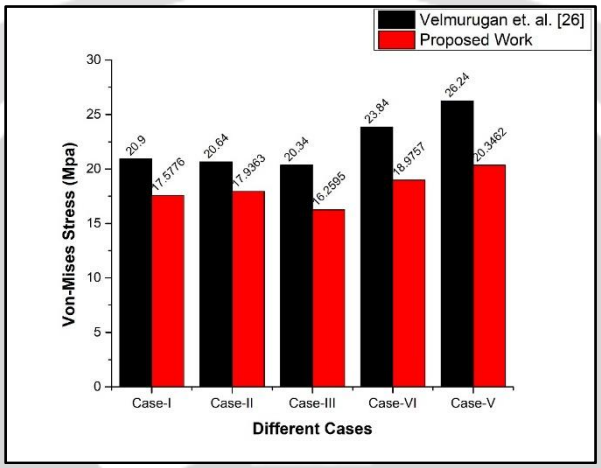


Fig 5. Graphical representation of Von-Mises stress between existing and proposed work

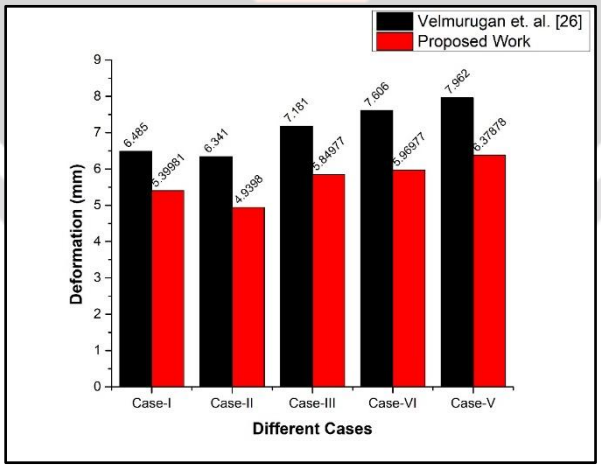


Fig 6. Graphical representation of deformation between existing and proposed work

5. Conclusion

The present work focuses on the progress or improvement of natural fiber reinforced composite. In area of industries are in constant search of new materials to minimum costs and profit margins. Now a day's researchers are forward to on development of bio composites to replace traditional and costly materials which are under criteria. In this work the combination of different natural fibers obtained to give better mechanical and physical properties.

This work is mainly concluded that the from graphical representation between existing and proposed work. In all results tables and figures which is clearly seen that the proposed work is more useful as compared to the existing. The previous work with only one fiber with different layer thickness but in this work used the hybrid composite i.e. three natural fiber like palm, coconut coir and human hair, which is made good bound with each layer using epoxy resign and give the more expected result in present. Hence in future we have to use this hybrid material which are biodegradable and safe.

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