International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN(P): 2249-6890; ISSN(E): 2249-8001
Vol. 8, Issue 3, Jun 2018, 943-948

A REVIEW ON NATURAL FIBER HYBRID COMPOSITES

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ABSTRACT

In modern industries, the majority of the conventional materials have been replaced by Natural fiber composites due to its high strength to weight ratio, biodegradable, eco-friendly environment, etc. Moreover, natural fibers are easily available and it can be extracted from the trees. Also, it has good mechanical properties, high durability, and more corrosion resistance. Based on various literature surveys, natural fibers are a very good alternative for Engineering and Manufacturing industries. By keeping these reasons in mind, these paper reviews properties and mechanical characterization of some of natural fiber hybrid composites. A brief study has been carried out to acquire exposed and practical knowledge on the use of natural fibers such as banana, jute, sisal, hemp, flax, kenaf etc..

KEYWORDS: Banana fiber, Jute Fiber, Characterization & Testing

Received: Mar 12, 2018; **Accepted:** May 28, 2018; **Published:** Jun 13, 2018; **Paper Id.:** IJMPERDJUN2018100

A Review

INTRODUCTION

Nowadays, natural fiber composites are replacing conventional materials which are in automotive, building and aerospace applications due to the easy extraction method and biodegradable behavior.

REVIEW ON BANANA HYBRID COMPOSITES

Murali Mohanrao et al [1] have conducted various tests and recorded various properties such as tensile, flexural and dielectric of composites by using vakka fiber as reinforcement into the polyester resin matrix. Fabrication of composite is done by using hand lay-up method. The results of the composite samples of various tests are compared with existing natural fibers such as sisal, bamboo and banana. The results show that the properties increases with increase in volume fraction of fiber for vakka fiber composite. These fibers possess good dielectric strength when compared to other natural fibers and it can be used in electrical insulation applications.

Boopalan et al [2] has investigated and compared the mechanical properties of jute fiber hybridized with banana fiber. The fabrication of composite has been done by using molding technique with various weight proportions. Various tests such as tensile, flexural, impact, thermal and water absorption has been carried out to determine the properties of the composites. The results show that the addition of banana fiber up to 50% by weight with jute fiber increases mechanical and thermal properties. SEM also has been carried out to study the internal structure of the composite laminate and it was found that less voids are observed due to fiber pullout.

William Jordan et al [3] have studied different chemical treatments such as peroxide and permanganate to accelerate better interfacial bonding between banana and low density polyethylene matrix. The effect of treatments on banana fiber has been studied in detail. The study concluded that both the peroxide and permanganate treatment increases the mechanical properties as compared it with untreated fibers.

Amir et al [4] have investigated the effect of fiber configurations of banana fiber reinforced with malefic anhydride grafted polypropylene matrix. Three different configurations such as raw banana, banana yarn and banana mat were considered. Tensile and flexural properties were determined for three configurations. SEM has been done to explain about the fracture behavior of the composite. The results concluded that banana yarn is the best configuration for obtaining best mechanical properties.

Sapaun et al [5] have experimentally investigated the woven banana fiber reinforced epoxy composites with various geometries along x, y and z directions. Tensile and flexural test have been carried out and the corresponding stress Vs strain graphs have been plotted. The result shows that the maximum values are obtained in x and y directions for both the tests. ANOVA has been carried out to determine the most significant results obtained from all the samples are not significant and banana fiber can be used as household utilities.

Rajesh Ghosh et al [6] have investigated the effect of ultrasonic treatment on water absorption characteristics and mechanical properties of banana fiber composite. In this work, diffusion kinetics were applied with the help of mathematical tools. The result shows that the sample of ultrasonic is having higher mechanical properties than the untreated fiber. SEM images show that it has less pull outs and the penetration of the resin is found to be good which indicates a strong bond between the fiber and the resin.

Benitez et al [7] have investigated the effect of physical and chemical treatments on banana fiber extracted from the canary banana tree for the use of reinforcement with polymeric matrix. The sample is fabricated by the injection molding method. Here, Sodium hydroxide (Na OH) and malefic hydride were used to treat the fiber in different environmental conditions. Finally the composite samples were examined by thermo gravimetric analysis and Fourier transforms infrared spectroscopy. The result shows that there is a significant improvement in the mechanical properties when compared to other fibers which may cause more use in engineering industries.

Ramachandran et al [8] have experimentally investigated the effect of natural fibers such as bamboo, banana fiber and linen fiber reinforced with epoxy resin with various orientations. The fabrication of composite sample is done by hand lay-up method. Various tests such as impact test, Fourier transform infrared, Rock well and hardness test has been carried out to determine the mechanical behavior of the composite. The result shows that better values are obtained with the combination of bamboo and banana fiber for both the tests.

Arthanareeswaran et al [9] have experimentally investigated the effect of glass fiber hybridized with natural fibers. Hand lay-up method is used to fabricate nine different composite samples in different sequences. Various mechanical tests have been carried out and compared. SEM has also been done to determine the fracture behavior of the composite sample. The result found that addition of glass fiber increases the strength of the hybrid composites.

REVIEW ON JUTE HYBRID COMPOSITES

Yallew et al [10] have experimentally investigated the effect of wear characteristics of jute fiber reinforced

polypropylene composites. In this work, compression molding process is used for the preparation of the specimen. The effect of the reinforcement under friction was investigated. The apparatus used here is pinned on the disk test to determine the wear and friction coefficient. The input parameters such as load, sliding distance and speed are varied and the output responses are recorded. SEM has been done to observe the internal structure of the composite laminate. The result shows that the percentage reduction is observed in both the friction coefficient and the specific wear rate.

Sumi and Unnikrishnan [11] have reviewed the paper based on various types of surface treatments for natural fibers and their properties. The various types of properties such as cell dimensions, structure, angle and defects are discussed in detail. Various treatments such as enzyme treatment, alkali treatment, transesterification using vegetable oils, alkalization treatment are elaborated in detail. Various compositions of the fibers have been prepared and compared. The review results show that the development and applications of natural fibers. The modifications and techniques are suitable on a design basis for optimum results.

Ku et al [12] have reviewed the tensile properties of natural fiber reinforced polymer composites. In this review, mechanical properties, eco-friendly environment conditions, bio degradability characteristics have been studied in detail. Several chemical properties are considered to improve interfacing matrix fiber bonding. The tensile properties of natural fiber composites are mainly influenced by the interfacial adhesion between the matrix and the fibers. In general, tensile strength of natural fiber reinforced polymer composites increase with fiber content and attain maximum value and then the value diminishes, Whereas, Young's modulus of natural fiber increases with increase of fiber loading. Mathematical modeling has been done to predict the experimental results using Halpin-Tsai equation which is the most effective method to predict the Young's modulus of composites containing different types of natural fibers.

Thakur et al [13] have reviewed the recent trends in natural cellulose fibers from bio renewable resources. The intrinsic properties such as bio degradability, environmental friendliness, flexibility and mechanical properties have been studied in detail. Also the processing of bio renewable natural cellulose fibers, chemical analysis of cellulose fibers, synthesis of polymer resins, different steps to prepare cellulose based green polymer composites and applications are discussed in detail. This review paper concluded to demonstrate the recent developments and applications of natural cellulose fibers and their polymer materials.

Bella et al [14] have experimentally investigated the effect of natural fiber reinforcements in various lime plasters which were prepared and analyzed to evaluate their performance. Each lime plaster was realized by adding to the mortar with 0.2% by weight of polypropylene. The fiber, such as sisal and kenaf is used as reinforcement. Compression and Flexural strength, resistance to freeze/thaw conditions and to the marine environment of lime plasters were analyzed. The result shows that the natural fibers considered to be the best alternative as compared to polypropylene as reinforcement of lime plasters. The result concluded that the decreasing trend of mechanical properties due to freeze/thaw cycles.

Saaidia et al [15] have described the tensile characteristics of raw and treated jute fibers. Fibers have been treated with alkaline solutions at varying concentrations and temperatures. The results show that there is a variation in experimental results, ANOVA techniques are performed for optimizing the obtained results. Based on experimental results, the concentration of 2% Na OH solution with 2 hours immersion time has been recorded as the optimal value. Morphological analysis has been carried out to determine the internal structure of the fiber under different classes of yarns.

Jiri Militky and Abdul Jabber [16] have comparatively studied the creep performance of the treated and untreated

jute fiber. The process has been carried out by hand lay-up method in the compression molding machine. The results show that the treated jute fibers inhibit has less creep strain when compared to the untreated jute fiber. The interfacial adhesion between the fibers and the resins were obtained by dynamic mechanical analyzing.

Radhikalondheet al [17] has studied the moisture absorption and the mechanical characteristics of the jute fiber filled with epoxy resins. Jute fibers have been treated with Sodium hydroxide (Na OH) solution initially and then the treated fibers are used in the fabrication purpose to enhance the adhesion property between the fiber and resins. Then the laminate has been coated with acrylic paint for obtaining better results when subjected to various PH media. The results show that the more reduction in the moisture absorption of the jute fiber.

Tessuo et al [18] have been experimentally investigated the effect of mechanical properties of jute fiber fabricated by using Spray technique. In this work, various motion work analysis tests have been done to optimism spray techniques, dynamic characterization and the dimensional stability of the Composite laminate. The results show that the spray molding equipment is very flexible since it prepares the composite laminate very easily.

Vijaya Ramnath et al [19, 20] has experimentally investigated the mechanical behavior of various natural fiber hybrid composites by varying configurations and orientations. Various fabrication techniques have been incorporated to develop good composite materials for applications in various engineering industries. The results show that there is a significant improvement in mechanical property to be considered as an alternative to conventional materials since it has a great impact in future technology.

Srinivasan, et al (21) investigated Mechanical and Thermal Properties of Banana-Flax hybrid composites, and concluded that strength can be increased by increasing the fiber volume fraction.

REVIEW ON OTHER HYBRID COMPOSITES

Vijaya Ramnath (22, 23, and 27) studied the mechanical behavior of jute with banana and albaca fibers. They found that fiber layering sequence also has an impact on mechanical behavior of the composites. It was concluded that fibers arranged in 40^{o} inclination have better mechanical properties than other layering orientation sequence.

Claudia Merlini etal (24) investigated the influence of fiber treatment on physical and chemical properties of banana - polyurethane composite. They found that the tensile strength and Young's modulus increased by increasing the fiber volume fraction. They also recorded that the treated banana fiber composite has better tensile behavior than untreated composite which is due to increased interfacial reactions between treated fiber and polyurethane materials.

Bashar (25) performed thermo mechanical characterization of banana fiber reinforced with PVC Composite for piping material applications by using Compressing molding process. They observed that the composition consisting of 8% banana, 72% PVC and 20% of filler exhibits mechanical strength of 42 MPa which is the best as compared with other compositions. The result of thermal analysis shows that the presence of filler in composite increases the thermal stability of composite about 39% as that of PVC.

Satishetal (26) predicted swelling behavior of jute banana composite by immersing specimen in the water untill constant absorption is ensured. They found that jute fiber composite absorbs less water than banana fiber due to its better adhesion of fibers and matrix and also better corrosion resistance.

CONCLUSIONS

This paper reviewed various research works which are carried out with a banana and jute fibers as reinforcement for the fabrication of composites. The following conclusions were arrived based on research papers. i) Treated fiber has better mechanical strength than untreated fiber, ii) Fiber volume fraction increases the strength of the composites, iii) Fiber layering sequence has a significant impact for improving the mechanical behavior of the composites and iv) Addition of Glass fiber increases the strength of the Composite laminates.

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