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Short Communication

Reinforced Composites by Palmyra Palm Leaf Stalk fiber: A Basic Review on Parameters, Method, and Performance

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Abstract

Natural fiber reinforced composite materials are now a hot topic that is extensively discussed and investigated in this era. The applications of natural fiber reinforced composites are constantly increasing, especially for sustainable issues. There are several natural fibers available used for reinforced composite materials. Among them palmyra palm leaf stalk fiber is mostly famous used as reinforced composite materials. This short review study represents the concept of reinforced composite manufactured by palmyra palm leaf stalk fiber. It provides an overview of reinforced composite by palmyra palm leaf stalk fiber. Basically, this study addresses materials (palmyra palm leaf stalk fiber, alkali, matrix and epoxy resin) used for reinforced composite of palmyra palm leaf stalk fiber. Besides, it illustrates the manufacturing techniques of reinforced composite materials of palmyra palm leaf stalk fiber. Finally, it addresses the applications of reinforced composite materials that are manufactured by palmyra palm leaf stalk fiber.

Keywords: Reinforced composite; Palmyra palm leaf stalk fiber; Parameters; Manufacturing techniques; Applications

Introduction

Composite materials are macroscopic mixtures of two or more different materials with enhanced qualities [1]. A composite is made of two components; one of the materials is the reinforcing material, which can take the shape of sheets, fibers, or polymers, and the other material is the matrix material. Both materials can be made of metal, ceramic, or polymer. In composite materials, the fiber phase serves as the load-bearing component since it is stiffer and stronger than the matrix phase. The matrix is more ductile than fibers since it is used to distribute load among the fibers. Additionally, it contributes to the hardness of composites [2,3]. Furthermore, it safeguards against environmental harm like dirt, dust, etc. Composites are employed for electrical, environmental, thermal, and structural purposes in addition to structural features [4]. The composite is appropriately designed and produced, combining reinforcing strength with matrix toughness to achieve a combination of critical qualities that are not available in any one traditional material [4]. Hybrid composites, which are reinforced by two or more fibers in a matrix, are one way to create composites with desirable properties [5] natural fiber composites include advantages such as high specific strength, high specific modulus, light weight, low cost, less health risks, and biodegradability [6]. Natural fibers are materials that were generated by nature and are widely available, environmentally beneficial, and have a renewable characteristic. The fundamental processing conditions used to extract the fiber will determine the homogeneity during cultivation, on-growing, harvesting, and processing. Natural fibers are incredibly advantageous in that they are light in weight, but because of their low density, processing can be difficult because the fibers have a tendency to separate from the matrix, particularly liquid resins. Another problem with natural fibers that led to the delamination of composites is their propensity to absorb moisture. Therefore,

choosing the proper fiber extraction method and a processing technique to create composites by adding reinforcement from the fiber are the most important duties when dealing with NFRPC [7].

Many researchers have worked to create composite materials utilizing various natural fibers (with and without chemical treatment), matrices (thermoplastic, thermosetting plastic, etc.), and they have analyzed these materials for their physical, chemical, mechanical, thermal, and electrical properties. A portion of those authors have concentrated on creating and characterizing composites reinforced with short, short hybrid, long, long hybrid, palm/jute, palm/banana, and Borassus fruit fiber in various matrices. The highlights of those are listed below in the order of Borassus fruit, short, short hybrid, and long, long hybrid palmyra palm fiber reinforced polymer composites [7].

Many technical applications, including the building and automotive industries, accept natural fibers because of their low cost, less weight, and environmental friendliness [8]. Sadly, there are some problems with natural fiber-reinforced polymer composites since the fibers absorb moisture, which causes dimensional instability in the composites. The adhesion between fiber and matrix is hampered by the hydrophobic polymer matrix and the hydrophilic of natural fiber [9] (Figure 1). Before creating the composite materials, this issue can be solved by chemically treating the fiber surfaces [10].

Figure 1: (a) Palmyra Palm Leaf Stalk (b) Extracted Palmyra Palm Leaf Stalk Fiber [9].

Materials for Reinforced Composite

Palmyra palm leaf stalk fiber

The Palmyra palm tree's leaf stalk was used to harvest the fibers. Manual labor was used to remove the skin and thorns from the leaf stalk's sides (Figure 1). The leaf stalks were then retted in water for 20 days, and the fibers were manually separated from the stalk by gently hammering the stalk. The moisture and other contaminants stuck to the fibers were then removed, and the fibers were cleansed, rinsed, and dried [11].

Alkali treatment

A determined amount of PPLSF was exposed to 5% NaOH for 30 minutes at room temperature. After washing the fibers with very diluted hydrochloric acid (HCl), they were again cleaned with tap water. After drying the fibers in an oven set at 70 °C, washing was repeated numerous times until the fibers were free of alkali [11].

Matrix

Unsaturated polyester resin is used for fabricating composites for tensile, flexural, impact and dielectric test specimens [7] (Figure 2).

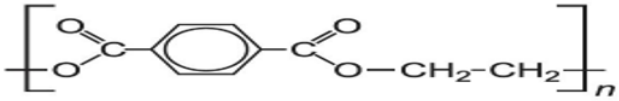

Figure 2: Chemical structure of polyester.

Epoxy resin

Epoxide functional group is found in epoxy resins. These resins are referred to as polyepoxides because they belong to a class of pre- and polymers that include epoxide groups. They include a range of epoxy resins, including aliphatic epoxy resins, epoxy resins with a bisphenol base, and epoxy resins from Novolac [12]. Through a catalytic reaction known as homo-polymerization, these epoxy resins can react or crosslink with one another as well as with a wide range of co-reactants, such as amines, acids, acid anhydrides, phenols, and alcohols. Hardeners or healers are the terms used to describe these co-reactants [4].

Manufacturing Techniques

The hand lay-up approach is used to create the composites in accordance with a process detailed previously by Srinivasababu [13]. Hand layup is one of the oldest open mold composite production methods. It was used to make the boat hulls during the middle of the last century. It is a type of process in which layers of resin and reinforcing material are put into a shape manually onto an open mold where several layers may be used to get desired thickness of final product. This process required five main steps which are cleaning, gel coating, laying up, curing and part removal. These steps are more or less common for all open mold processes. The third (laying up) and fourth (curing) steps actually differ in different systems. After finishing this step, the outside ages of the finish material need to be trimmed and machined.

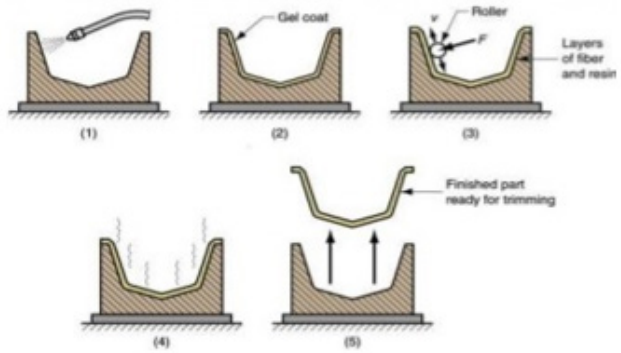

Figure 3: Hand layup techniques [14].

Clearing the surface of the mold is the first step of the process and then releasing agents are applied for easy removal. In the

second step, coating of thin gel needs to be applied to surface of the molding. It is generally done to obtain better surface quality. In order to get decorated surface, the coating may contain pigments while the gel is applied by using spray gun at most cases (Figure 3) [14].

After that, the resin and fibers are manually applied to the open mold in successive layers in the third step of operation. Heavy roll needs to be applied after putting each layer for consolidation to ensure impregnation of resin into the fiber and to remove any air bubbles. The fourth step is the curing stage, the purpose of this step is hardening the composite. Generally, the hardening takes place by cross linking by which a cross linking agent is applied. This step works at room temp. for hand layup system. In the fifth and final step, the produce composite is removed from the mold and then it's ready for finishing processes.

Fiber reinforcement can be applied in various forms such as chopped stands mats, woven roving, woven yarns or clothes. In most cases, the fibers come in the batts form, the batts are put or straight way or unrolled during layup. Fiber bats can be cut to any size by using templates or patterns. After curing reinforcing layers are put on prepared mold followed by wetting with the resin mixture. The resin contains hardener. The hardener solidifies the resin within a fixed amount of time. That's why the resin needs to be applied as soon as possible. The resin can either be brushed or sprayed by spray gun with a pumping system. The brushing method is most frequently used but it gives a very low production rate. However, many manufacturers have started to prefer to use spray guns and pumping system in order to achieve quick and uniform resin mixing.

Applications

While there are several fibers taken from numerous sources, they are not entirely sufficient to meet the demands in the corresponding applications. When compared to palmyra palm leaf stalk fiber, which is the first of its kind and is only introduced in this work, the fiber's cross-sectional variability is considerably more variable along its length. Also covered are the characteristics of the various natural fibers [7]. Better wear performance compared to resin was achieved thanks to good fiber matrix adhesion, reduced debonding, bonding of the fibers in the direction of sliding, and creation of a polyester film on the composite surface [11]. Utilizing natural fiber composites to make lightweight automotive and industrial components is advantageous to its field of use [9].

Conclusion

This study has been done to find out the parameter, Method, and Performance of Palmyra Palm Leaf Stalk fiber. The addition of natural fiber as reinforcement can do several improvements including mechanical properties, degradability, light weight but it depends heavily on the adhesion between fiber and matrix. By this study it is clarified that Composite can be a greater efficient material for using in many purposes in different ways. But a wide range of investigation is necessary for this.

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