REVIEW ON POLYMER COMPOSITE MATERIALS

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ABSTRACT

This study focuses on the potential use of natural fibers in composite materials, their availability, processing features, mechanical and physical properties, and some of their applications in India. Composite materials consist of two or more constituent materials, the fibre and the matrix. Fibre reinforced polymer composites are becoming very popular and replacing conventional materials nowadays, because of their excellent properties suitable for various applications. The properties of fibre reinforced polymer composites are comparable to most conventional materials like metallic materials. Numbers of papers have been published in the field of high strength composites made up of glass fibres, carbon fibres, Kevlar fibres and carbon nanotubes. However, their utilizations are affected by their high cost, recyclability and biodegradability issues. The concern regarding environmental policies leads researchers to focus on natural fibre based composites. Natural fibre reinforced eco-friendly composites are becoming an attractive alternative for synthetic materials. Natural fibres are cheaper in cost, environment-friendly, renewable and bio-degradable. The properties of natural fibre reinforced polymer composites are determined by problems like poor bonding, poor wettability, and degradation at the fibre-matrix interface and the damage of the fibre during the manufacturing process.

Keywords: *NF-Natural fibre, NFC-National fibre composite*

INTRODUCTION

Composite are combination of two or more than two materials in which one of the material, is matrix phase (polymer, metal or ceramic) that is continuous phase and other is reinforcement phase (hair fiber, glass, graphite, and alumina etc.) that may be continuous or discontinuous phase. Composite materials are formed at interface phase zone where matrix phase and reinforcing phase combined to each other. A polymeric composite is prepare & design for a specific life span, depending on its Physical and mechanical properties, its purpose for a public building construction and for defense application, making floor carpets, etc

Fibers are hair-like materials that are continuous filaments or discrete elongated pieces. They are of two types: natural fiber (NF) and man-made, or synthetic fiber. NFs are a class of hair-like materials that are obtained from vegetables, animals, or minerals. Some of them can be spun into filaments, thread, or rope. They can be used as reinforcements in composites. NFs obtained from vegetables constitute cellulose, a polymer of glucose bound to lignin with varying amounts of other natural materials. Synthetic, or man-made fibers are generally obtained from synthetic materials such as petrochemicals, but some types are manufactured from natural cellulose, including rayon modal and lyocell. Bio composites are composite materials made of biodegradable matrix and biodegradable NFs as reinforcement. The development of bio composites has attracted great interest due to their environmental benefit (i.e., biodegradability) and improved properties. Asian people had been using NFs for many years; for instance, jute available in India has been used as reinforcement in many materials. NFs are increasingly used in automotive and packaging materials. In western Europe, NF used in composites is expected to reach 100,000 tons by 2010.The cost factor is more favorable and almost all the leading car manufacturers have switched to the use of plant fibers for several parts in the automotive sector. Being one of the fastest developing countries in the world, a great deal of international attention is focused on India. It is the seventh largest country in the world in terms of its geographical size. Increased use of natural fiber composites (NFC) as raw materials can be found in developing countries like India. Ninety percent of the world's jute is supplied from India and Bangladesh and 75% of kenaf production from India and China. India has abundant resources for other NFs, namely, silk, cotton, sisal, banana, coir, etc., available

in many parts of the country. The present production level of NFs in India is more compared to previous years. India is the world's second largest producer and consumer of fibers, textiles, and manufactured products, next to China. The country has diverse agro-climatic conditions and consumer preferences, and hence it produces a wide variety of agricultural fibers.

FABRICATION PROCESS

There are numerous methods for fabricating composite components. Some methods have been borrowed (injection molding, for example), but many were developed to meet specific design or manufacturing challenges. Selection of a method for a particular part, therefore, will depend on the materials, the part design and end-use or application. Composite fabrication processes involve some form of molding, to shape the resin and reinforcement. A mold tool is required to give the unformed resin /fiber combination its shape prior to and during cure.

- The most basic fabrication method for thermoset composites is hand layup, which typically consists of laying dry fabric layers, or "plies," or prepreg plies, by hand onto a tool to form a laminate stack. Resin is applied to the dry plies after layup is complete (e.g., by means of resin infusion). Several curing methods are available. The most basic is simply to allow cure to occur at room temperature. Cure can be accelerated, however, by applying heat, typically with an oven, and pressure, by means of a vacuum. Many high-performance thermoset parts require heat and high consolidation pressure to cure - conditions that require the use of an autoclave. Autoclaves, generally, are expensive to buy and operate. Manufacturers that are equipped with autoclaves usually cure a number of parts simultaneously. Computer systems monitor and control autoclave temperature, pressure, vacuum and inert atmosphere, which allows unattended and/or remote supervision of the cure process and maximizes efficient use of the technique.
- Electron-beam (E-beam) curing has been explored as an efficient curing method for thin laminates. In Ebeam curing, the composite layup is exposed to a stream of electrons that provide ionizing radiation, causing polymerization and crosslinking in radiation sensitive resins.
- X-ray and microwave curing technologies work in a similar manner.
- A fourth alternative, ultraviolet (UV) curing, involves the use of UV radiation to activate a photo initiator added to a thermoset resin, which, when activated, sets off a crosslinking reaction. UV curing requires light permeable resin and reinforcements.
- OPEN MOULDING: Open contact molding in one-sided molds is a low cost, common process for making fiberglass composite products. Typically used for boat hulls and decks, RV components, truck cabs and fenders, spas, bathtubs, shower stalls and other relatively large, noncomplex shapes, open molding involves either hand layup or a semi-automated alternative, spray up. In an open-mold spray up application, the mold is first treated with mold release. If a gel coat is used, it is typically sprayed into the mold after the mold release has been applied. In the final steps of the spray up process, workers compact the laminate by hand with rollers. Wood, foam or other core material may then be added, and a second spray up layer imbeds the core between the laminate skins. The part is then cured, cooled and removed from the reusable mold. Hand layup and spray up methods are often used in tandem to reduce labor.
- RESIN INFUSION PROCESSES**:** A common alternative is resin transfer molding (RTM), sometimes referred to as liquid molding. The benefits of RTM are impressive. Generally, the dry preforms and resins used in RTM are less expensive than prepreg material and can be stored at room temperature. The process can produce thick, near-net shape parts, eliminating most post-fabrication work. It also yields dimensionally accurate complex parts with good surface detail and delivers a smooth finish on all exposed surfaces. It is possible to place inserts inside the preform before the mold is closed, allowing the RTM process to accommodate core materials and integrate "molded in" fittings and other hardware into the part structure. Finally, RTM significantly cuts cycle times and can be adapted for use as one stage in an automated, repeatable manufacturing process for even greater efficiency, reducing cycle time from what can be several days, typical of hand layup, to just hours - or even minutes.
- In contrast to RTM, where resin and catalyst are premixed prior to injection under pressure into the mold, reaction injection molding (RIM) injects a rapid-cure resin and a catalyst into the mold in two separate streams. Mixing and the resulting chemical reaction occur in the mold instead of in a dispensing head. Automotive industry suppliers combine structural RIM (SRIM) with rapid preforming methods to fabricate

structural parts that don't require a Class A finish. Programmable robots have become a common means to spray a chopped fiberglass/binder combination onto a vacuum equipped preform screen or mold.

CONCLUSION

NF processing in developing countries like India is a labor-intensive manual process. Increased use of NFC may also find developing countries supplying raw materials and using their potential use in economies. In India there seems to be a promising and huge potential for the production and application of NFC in industries. Utilizing whole fiber not only provided good properties but will also eliminate the need for processing the fiber leading to lower costs and superior characteristics. The tensile properties can be enhanced with the increasing percentage of the fiber and also with different resin. Another way to enhance the composite properties is to determine an effective treatment to eliminate lack of adhesion between matrix and fiber.

The mechanical behaviors of short natural fibre reinforced natural rubber composites are studied. The fibre matrix interaction was improved by modifying the surface properties of the fibre, first to increase the area and contact and then to expose further the cellulose microfibrils. And thus to improve fibre wetting and impregnation. The mechanical properties observed between the different fibre surface conditions and the untreated fibres showed the interface strength increased only by changing the mechanical interaction and the chemical interactions between fibre and matrix.

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