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A STUDY ON CHARACTERISTICS OF NATURAL FIBRE

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Abstract: Natural fibres are getting attention from researchers to utilize in polymer composites due to their ecofriendly nature and sustainability. Natural fibres due to its renewable, ecofriendly and biodegradable properties find its application in wide array of fields. The natural fibres can be reinforced with matrix components like epoxy resin and Polylactic acid to improve their productivity and performance. To understand the characteristics of the natural fibres the various test has to be conducted.

Keywords: Natural fibres, Reinforcement and epoxy resin.

I INTRODUCTION

FRP usually referred to as fibre reinforced polymer composite is a quite new material in the various applications such as construction and building industry compared to concrete and steel. Composites possess the desired and preferred properties by coalescing dissimilar constituents in a cautious and judicious way. Generally they possess higher specific modulus and high specific strength enabling them as a valuable material in huge number of industrialized requests which requires such features. Natural fibre reinforced composites found to be an alternative solution to the ever depleting petroleum sources thus they receive greater attention, attraction from research scientist and community. Manufacturer and scientists attracted towards natural fibre based composites due to its biodegradability, light in weight, nontoxic and relatively stronger and consider being virtuous products which can be use in construction industry, automotive industry and for furniture production. Natural fibre composites have better formability, abundant, renewable, cost effective, possess tool wearing rates, thermal insulation properties, acoustic properties, sufficient energy requirements and safer towards health. Many innumerable demerits such as hydrophilic in nature, poor fibre/matrix interfacial adhesion and poor thermal stability of natural fibres can be overcome by chemical treatment or compatibilizer which amended the adhesion between the fibre and matrix. Composite of polymers and kenaf fibre possess the variances and incomparability in terms of their polarity structures. Based on the origin natural fibres are categorized as animal based and plant based. Animal-based fibres are wool, silk, etc. and natural fibres based on plant includes sisal, coir, ramie, jute, bamboo, pineapple and many more. Lignocellulosic fibres possess many compensations of being financially reasonable to manufacture such as lightweight, eco-friendly, harmless to health, high stiffness and specific strength which provides a probable substitute to the synthetic or artificial fibre. The reinforcing capability of the fibres mainly influenced by various aspects such as polarity of the fibre, mechanical strength of the fibres, surface appearances, and existence of reactive centres. Moreover many of the natural fibres properties are governed by several factors such as climate, harvest, maturity, variety, decortications, retting degree, disintegration (steam explosion treatment, mechanical), fibre modification, technical and also textile processes (spinning and carding). In spite of these promising features shown by natural fibres certain major drawbacks are also underlined like water absorption, strength degradation, lack in thermal stability lowered impact properties but it has been found that these can be improved and overcome by hybridization with either natural or synthetic fibre.

II MATERIALS AND METHODS

2.1 Sisal Fibre

Sisal fibres are stiff fibres extracted from an agave plant. These fibres are straight, smooth and yellow in colour. Strength, durability and ability to stretch are some important properties of sisal fibres.

2.2 Pineapple Fibre

Pineapple Leaf Fibre (PALF) is one such fibre source known from a long time obtained from the leaves of pineapple plant from the family of Bromeliaceae.

2.3 Flax Fibre

Flax fibres come from the flax plant; one species of Linum usitatissimumis breed and is widely cultivated in West Europe where the daily temperature is generally below 30°C. The diameter of the flax stem is in the range of 1–2 mm, with a height of about 80 cm.

2.4 Kenaf Fibre

Kenaf (Hibiscus cannabinus L.) is a traditional, third world crop after wood and bamboo that is poised to be introduced as a new annually renewable source of industrial purpose in the so called developed economies. Kenaf is a warm-season annual fibre crop growing in temperate and tropical areas. It is related to cotton, okra and hibiscus due to systematic. It is a fibrous plant, consisting of an inner core fiber (75–60 %), which produces low quality pulp and an outer bast fiber (25–40 %), which produces high quality pulp, in the stem.

2.5 Matrix and Hardener

Epoxy resin (LY556) is used as a matrix which was purchased from M/s Covaiseenu and Company, Coimbatore. HY 951 is used as a curing agent who was obtained from M/s Covaiseenu and Company, Coimbatore. In the present investigation, 10% by weight has been used in all material developed.

2.6 Chemical Treatment

Interaction between fibre and matrix plays a vital role in finding the mechanical characteristics of the composites. Since applied stress is transferred between matrix and fibres across the interface, good interfacial bonding is required to obtain optimum reinforcement although, it is possible to have an interface that is too strong, enabling crack propagation which can reduce toughness and strength. However, for Bio Fibre Reinforced Composites there is usually limited interaction between the hydrophilic fibres and hydrophobic matrices which leading to poor interfacial bonding limiting mechanical performance as well as low moisture resistance affecting long term properties. For bonding to occur, fibre and matrix must be brought into intimate contact; wettability can be regarded as an essential precursor to bonding. Insufficient fibre wetting results in interfacial defects which can act as stress concentrators. Fibre wettability has been shown to affect the tensile and flexural strength of composites. Chemical treatment can enhance the wettability of the fiber and thus improve the adhesion strength. Interfacial bonding can occur by means of mechanisms of molecular interlocking, electrostatic bonding, chemical bonding and inter-diffusion bonding. Mechanical interlocking occurs to a greater extent when the fibre surface is rough and increases the interfacial shear strength.

For that, alkaline treatment using sodium hydroxide (NaOH) is the most commonly used chemical treatment for bleaching and cleaning the surface of bio fibers to produce high-quality fibers. 5% sodium hydroxide solution was prepared using NaOH pellets and distilled water. Pineapple, sisal, flax and kenaf fibres were then dipped in the solution for 3 hours separately. Solution preparation and fibres immersed in solution. Then it was washed with flow water. Then it was kept in hot air oven for 4 hours at 60°C.

2.7 Preparation of Composites

Fibre orientation and volume fraction are the two important factors that influence the properties of the composite. In this research, all the bio fibres are used in the form of long fibers and epoxy resin used in the form of continuous phase to the weight fraction of 40% and 60% respectively to prepare the composites. The epoxy resin LY556 and the corresponding hardener (HY951) were mixed in a ratio of 10:1 by weight as recommended. The mixing was done thoroughly before the mixture filled into the mould and pressed in a hydraulic press at the temperature of 130ºC for 45 minutes and a pressure of 35 kg/cm² for 45 minutes is applied before it is removed from the mould. Then, this sample is post cured at standard atmosphere for some period of time to study the effect of post curing time on mechanical properties.

III MECHANICAL TESTS

3.1 Tensile Test

The tensile test samples were prepared as per ASTM D3039 standard. The dimensions, gauge length and cross-head speeds were chosen as per ASTM D3039 standard. A tensile test involves mounting the sample in a clamp and subjecting it to the tension. The testing process involves placing the test samples in the testing machine and applying tension to until it fractures.

3.2 Impact Test

Impact property of a composite is the measure of the total energy dissipated in the material before its final failure occurs under shock loading. The impact test samples are cut from respective composites according to the ASTM A370 standard and the test carried out in the izod impact testing machine.

3.3 Flexural Test

The flexural samples were prepared according to the ASTM D790 standard. The 3-point flexure test is the most common flexural test for composite materials. Specimen deflection is measured by the crosshead position. The testing process involves placing the sample in the Universal Testing Machine (UTM) and applying force to it until it fractures.

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IV MORPHOLOGICAL TESTS

4.1 SEM Analysis

For morphological study, the scanning electron microscope was used to reveal fractured surface of composites which together bonded between the fiber and matrix. Scanning electron microscope was used to study the measure of adhesiveness and interaction between natural fibers and epoxy resin. Due to poor surface roughness of fibers, aspect ratio were increased which causes better adhesion between fiber and resin.

4.2 FTIR Analysis

Fourier Transform Infrared Spectroscopy, also known as FTIR Analysis or FTIR Spectroscopy, is an analytical technique used to identify organic, polymeric, and, in some cases, inorganic materials. Fourier-transform infrared spectroscopy is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a wide spectral range. This confers a significant advantage over a dispersive spectrometer, which measures intensity over a narrow range of wavelengths at a time. The FTIR instrument sends infrared radiation of about 10,000 to 100 cm-1 through a sample, with some radiation absorbed and some passed through. The absorbed radiation is converted into rotational and/or vibrational energy by the sample molecules. The resulting signal at the detector presents as a spectrum, typically from 4000 cm-1 to 400cm-1, representing a molecular fingerprint of the sample. Each molecule or chemical structure will produce a unique spectral fingerprint, making FTIR analysis a great tool for chemical identification.

4.3 Chemical Study

The major biochemical ingredients of Natural fibres such as cellulose, hemicellulose, lignin and wax content are determined using standard test procedures. The ash content is quantified as per ASTM E1755-61 standard, whereas the moisture content is determined by drying the sample in an oven at 104 ˚C for 4 hours.

4.4 XRD Analysis

X-ray diffraction (XRD) is an effective method for determining the crystal structure of materials. It detects crystalline materials having crystal domains greater than 3-5 nm. It is used to characterize bulk crystal structure and chemical phase composition.

X-ray is a form of electromagnetic radiation having range of wavelength from 0.01-0.7 nm which is comparable with the spacings between lattice planes in the crystal. Spacing between atoms in metals ranges from 0.2-0.3 nm. When an incident beam of X-rays interacts with the target atom, X-ray photons are scattered in different directions. Scattering is elastic when there is no change in energy between the incident photon and the scattered photon. In inelastic scattering the scattered photon loses energy. These scattered waves may super impose and when the waves are in phase then the interference is constructive and if out of phase then destructive interference occurs. Atoms in crystal planes form a periodic array of coherent scatters. Diffraction from different planes of atoms produces a diffraction pattern, which contains information about the atomic arrangement within the crystal.

4.5 Transmissibility Test

The transmissibility test was measured by using UCON vt-9008 and a mass block system. The data obtained was transmissibility versus frequency generated by VSC software. It was produced at two base excitation levels that are 1mm and 1.5mm, and the frequency range between 18-25Hz and 18-30Hz respectively.

4.6 Vibration Test

The vibration test was carried out by attached the composite vibration absorber on the fixed-fixed end beam. The external force at 1300 rpm was produced by the electric motor shaker. There were one until four absorbers attachment were tested, in which later the amplitude displacement was plotted against frequency.

V CONCLUSION

Thus, the aim of the study is to understand the tests to find out characteristics of the natural fibres and its significance in reducing the use of synthetic fibres. The different types of natural fibres were listed out and the procedures to find out the characteristics of those natural fibres were discussed. Natural fibres and natural fibre composites can be used in engineering applications because of their environmental suitability. Now a day's lot of new composites are generated technical and economic issues are noticed. Natural fibre/ Natural fibre reinforced epoxy composites with high durability and effective mechanical properties were developed in the last decade. The main challenges for the near future are to further improve the durability and the mechanical performance of these composites by decreasing the costs of fabrication while developing an eco-friendly strategy.

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