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RESEARCH ARTICLE

MECHANICAL BEHAVIOUR OF COIR FIBERS UNDER INFLUENCE OF NATURAL FIBER REINFORCED WITH POLYPROPYLENE COMPOSITES

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ABSTRACT

Coir fiber was selected for this study as it is non-toxic, low cost, high lignin content, low density, low cost, high lignin content, low density, low tensile strength, low tensile modulus and high range of elongation compared to other fibers. Composites were prepared using Coir fiber in the rough (raw) stage, after washing with tap water, and also subjected to various other treatments. After which their mechanical composition, Tensile, compressive, Flexural properties were determined and the results are discussed in the laboratory. There was a good improvement in their properties due to Mechanical composition modification and surface modification (fiber / matrix adhesion).

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INTRODUCTION

Composites usually man-made is a 3D combination of at least two chemically distinct materials, with an interface separating the components, created to obtain properties that can't be achieved by any of the components acting alone. Composite material can be defined as a structural material that consists of two or more combined constituents those are combined at a microscopically level and not soluble in each other. One is called the reinforcing phase, is in the form of sheets, fiber or particle and another one in which it is embedded is called matrix phase. The matrix phase materials are generally continuous; they may be metal, ceramic or polymer. The strong fiber surrounded by a weaker matrix material. The example of composites systems include concert reinforced with steel and epoxy reinforced with graphite fibers.

A. Overview of composites

Advantage of composite materials over conventional materials stem largely from their higher specific strength, stiffness and fatigue characteristics, which enables structural design to be more versatile when the composite phase materials. Composites are materials that comprise strong load carrying material (known as reinforcement) imbedded in weaker material (known as matrix). Reinforcement provides strength And rigidity, helping to support structural load. The matrix or binder (organic or inorganic) maintains the position and orientation of the reinforcement. Significantly together they produce a combination of qualities which individual constituents would be incapable of producing alone. The reinforcement may be platelets, particles or fibers and are usually added to improve mechanical properties such as stiffness, strength and toughness of the matrix material. Long fibers that are oriented in the direction of loading offer the most efficient load transfer. This is because the stress transfer zone extends only over a small part of the fiber-matrix interface and perturbation effects at fiber ends may be neglected.

B. Types of Composites

1. **Metal Matrix Composites (MMCs):** They have a metal matrix. Examples of matrices in such composites include aluminum, magnesium and titanium.
2. **Ceramic Matrix Composites (CMCs):** They have ceramic matrix such as alumina, calcium, alumina silicate reinforced by silicon carbide. The advantages of CMC include high strength, hardness, high service temperature limits for ceramics, chemical inertness and low density.
3. **Polymer Matrix Composites (PMCs):**These composites consist of a polymer thermoplastic or thermosetting reinforced by fiber (natural carbon or boron). They have greater strength and stiffness along

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with resistance to corrosion, low cost, high strength and simple manufacturing principles.

4. **Natural Fiber Composites:** By natural fiber composites we mean a composite material that is reinforced with fibers, particles or platelets from natural or renewable resources. Natural fibers include those made from plant, animal and mineral sources.

Advantages

High resistance to corrosion and fatigue degradation. High “strength to weight” ratio. Due to greater reliability, there are fewer inspection and structural repairs. High resistance to impact damage. Good heat sink properties of composites, especially carbon-carbon, combined with their light weight have extended their use for aircraft brakes. Improved friction and wear properties.

Disadvantages

High cost of raw materials. Matrix is weak, so low toughness. Difficult to attach. Matrix is subject to degradation of environment. Analysis is difficult.

C. Fiber

Fiber consists of thousands of filaments having a diameter of between 5-15 micrometer. Natural fiber used as a alternate for glass, motivated by potential advantages of lower raw material price, weight saving and thermal recycling or the ecological advantages of using resources which are renewable. Natural fiber have lower-durability and lower strength than glass fiber.

D. Coir fiber

Coir is a natural fiber extracted from the musk of coconut and used in product such as floor mats, doormats, brush, mattresses etc. We prefer coir fiber because it is easily available, low cost (chip), low moisture content etc.

1. Composition of coir fiber

Chemical and physical property: Coir is a lignocelluloses material, biodegradable. Length in cm. - 0.6 mm. Diameter /width in micron- 16.

2. Single fibers:

Length in inches- 6-8. Density (g/u) - 1.40. Tenacity (g/ten) - 10.0. Breaking elongation (%)- 30.Moisture regain at 65% RM (%)- 10.5.Swelling in water(diameter) - 5%.Chemical composition: Water soluble- 5.25%. Pectin and related compound- 3.00%. Hemicelluloses- 0.25%. Lignin- 45.84%.Cellulose- 43.44%. Ash- 2.22% and 100.00% waterproofs because of high lignin content coir and is resistant to damage by salt water.

E. Polypropylene

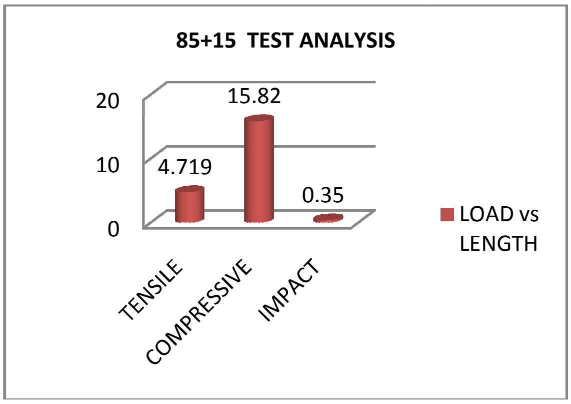
Polypropylene is a kind of polymer which gets transformed into liquid when it is heated. And when frozen, it turns into a glassy state. Polypropylene is a light weight material, high tensile strength, strong resistance towards stress sand cracking. Shape: Polypropylene is crystalline in nature and possesses a regular geometrical shape. Insulation: It acts as an excellent insulator. That means, it prevents flow of electricity through it. Moisture Absorption: Polypropylene does not get damaged by water exposure because its moisture absorption is very low. Melting point of polypropylene is 160°C. Corrosion: This polymer remains unaffected when it comes in contact with chemicals such as alkaline substances, acids, de-greasing agents, electrolytic attacks, etc. It is a non-toxic substance, does not get stained very easily and can. Be easily fabricated. It can retain its stiffness and flexibility intact Even at very high temperatures.

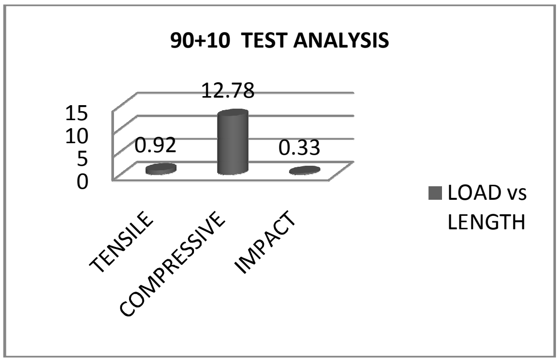
II. Literature Survey

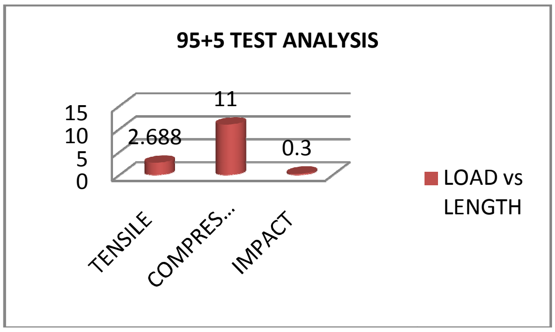
Coir–polyester composites with untreated and treated coir fibers, and with fiber loading of 17 wt%, were tested in tension, flexure and notched Izod impact. The results obtained with the untreated fibers show clear signs of the presence of a weak interface long pulled-out fibers without any resin adhered to the fibers and low mechanical properties were obtained. Even though showing better mechanical performance, the composites with treated fiber present, however only moderation the values of the mechanical property analyzed. Alkali treatment is also reported for coir fibers fiber–polyester composites, with volume fraction ranging from 10% to 30%, show better properties than composites with untreated fibers, but the flexural strength of these composites was consistently lower than that of the bare matrix. A maximum value of 42.3 MPa is reported next to a value of 48.5 MPa for the neat polyester. Acetylating of coir fibers increases the hydrophobic nature, increases the resistance to fungi attack and also increases the tensile strength of coir fiber composites. However, the fiber loading has to be fairly high, 45 wt% or even higher, to achieved a significant reinforcing effect when the composite is tested in tension. Moreover, even with high coir fiber loading fractions, there is no development in the flexural strength. From these results, it is clear that the usual fiber treatments reported so far did not significantly change the mechanical performance of coir–polyester composites. Even though there are several reports in the literature which discuss the mechanical property of natural fiber reinforced polymer composite. However, very limited work has been done on role of fiber length on mechanical behavior of coir fiber reinforced epoxy composite. Against this the present research work has been undertaken, with an objective to discover the potential of coir fiber as a reinforcing material in polymer composites and to investigate its effect on the mechanical behavior of the resulting composites. The present work aims to develop this new class of natural fiber based polymer composites with different fiber lengths and to analyze their mechanical property by experimentation.

RESULTS

The below results shows graphs between Load (Newton) versus Length (mm) and considerable improvement in tensile, compressive and impact stress were noticed.







S.No.	Sample Number	Impact Value for Given Sample in J
1	I_1	0.35
2	I_2	0.33
3	I_3	0.30

The above details refer to the impact test report for different samples of length.

MATERIALS AND METHODS

The raw materials used in this work are (1) Coconut fiber (2) Resin (3) Hardener.

Treatment of fiber

Fibers as received are washed with distilled water to remove the surface dirt present in the fibers and then the fibers are dried in air circulating oven at a temp of 1000c until it gains a constant weight. Then the fibers are designated as washed fibers. For de-waxing the coir fibers are cooked in a mixture of ethanol and benzene in a ratio 1:2. We took 300ml ethanol and 600ml benzene for this process. The fibers are cooked with these chemicals for 12hrs so that to attain hohlraum character which means the substances lying in layers with free spaces in between. During this process the fibers are cooked in this solution under gradual increase and decrease of temperature of the bath from 30-55.5c.This process of heating and cooling was done per every 2 hrs for a period 12 hrs. Finally the fiber bundles are removed from the mixture at 30c and washed with distilled water. Then the fibers are again dried in a oven at a temperature of 100c until it gets constant weight. Then the fiber is called as de-waxed coir fiber.

Conclusion

There are some studies on the poultry waste. For instance some studies carried out the use of CF as provender which is currently found that it is risky for the human health. most of the waste coir fiber have been still destroyed by using burning or burying methods, if the poultry waste can be utilised and used any engineering applications, they will be preferred due to low cost and superior characteristics and the most importantly they ecological and health problems. The compressive and flexural properties of the control at 5% composites, for the resins. Have significantly superior properties to the CF reinforced composite. The tensile and impact property values decrease when the fiber loading percentages increases. The compressive strength values increases when the fibre loading percentages increases, the reinforced composite better than at 5% level. Similar results were found in previous works in different loadings and resins.

It can be concluded that CF reinforced composite have potential applications due to its improved the behaviour, the tensile and flexural properties can be enhanced with the increasing percentage of CF and also different resin. Another way to enhance the composite properties is to determine an effective treatment to eliminate lack of adhesion between matrix and CF fiber to accomplish this project.

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