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Investigation on Mechanical Properties of Areca/Banana Reinforced Poly Epoxy Composite

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Abstract: In recent years natural fibres have appeared as one of the outstanding materials which comes under low cost, fairly good mechanical properties, nonabrasive and eco-friendly characteristics they are exploited as replacement for the conventional fibre, such as glass, aramid, and carbon. Natural fibres like sisal, banana, jute and coir is used as fibres in thermoset composite for applications in consumer goods, furniture, low cost housing and civil structures. In this work, the natural fibre chosen are areca fibre and banana fibre. Unidirectional mats were fabricated and layered up, arrangement with epoxy resin matrix. The laminate is manufactured using hand lay-up technique. The Mechanical properties such as, tensile strength, flexural strength and impact strength (as per ASTM standards) are analysed on the fabricated material. Also Micro structure of the composite is analysed using scanning electron microscope (SEM).

Keywords: Areca fibre; banana fibre, hand lay-up, epoxy, unidirectional, tensile, flexural, impact, Scanning electron microscope.

I. INTRODUCTION

A composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. A composite is something like concrete, where stones of various sizes are dotted in between cement. Reinforced concrete is also a composite made from steel reinforcing bars placed inside wet concrete—which makes it, in effect, a composite of a composite. Fibreglass is a composite of tiny glass shards glued inside plastic. In concrete, reinforced concrete, and fibreglass, the original ingredients are still easy to spot in the final material. So in concrete, you can clearly see the stones in the cement—they don't disappear or dissolve. The most important reason why we need composite materials is the versatility in their properties which enables them to be applied in large number of fields. Other reasons are their light weight, corrosion resistance and durability. The advantages of composite materials always beat their disadvantages hands down. The composites can be engineered to work according to our requirement. Nowadays, composite materials are used in large number of vast engineering fields such as aviation, automobile and robotics

II. LITERATURE REVIEW

This investigation study outlines some of the recent reports published in literature on composites with special emphasis on erosion wear behaviour of glass fibre reinforced polymer composites. As a result of the increasing demand for environmentally friendly materials and the desire to reduce the cost of traditional fibres (i.e., carbon, glass and aramid) reinforced petroleum-based composites, new bio-based composites have been developed. Researchers have begun to focus attention on natural fibre composites (i.e., bio composites), which are composed of natural or synthetic resins, reinforced with natural fibres. Natural fibres exhibit many advantageous properties, they are a low-density material yielding relatively lightweight composites with high specific properties. These fibres also offer significant cost advantages and ease of processing along with being a highly renewable resource, in turn reducing the dependency on foreign and domestic petroleum oil. Recent advances in the use of natural fibres (e.g., flax, cellulose, jute, hemp, straw, switch grass, kenaf, and bamboo) in composites have been reviewed by several authors.

III. PROPOSE OF THE RESEARCH WORK

The proposed system of this investigation is to analyse the basic mechanical properties of the natural fibre composite. Fabrication of areca and banana fibre reinforced epoxy based composite. And to use a different epoxy (B-11) which is only used for fibre glass. Evaluation of mechanical properties (tensile strength, flexural, and impact strength etc.) Besides the above all the objective is to develop new class of composites by incorporating areca fibre and banana fibre reinforcing phases into a polymeric resin. Also this work is expected to introduce a new class of polymer composite that might find many engineering applications and scanning electron microscope test was conducted for better view of the composite material's microscopic structure.

IV. MATERIALS USED

Areca leaf fibre, Banana stem fibre, □Resin B-11, □Hardener K-6

V. METHODOLOGY

A. Fibre Extraction

Retting is a process employing the action of micro-organisms and moisture on plants to dissolve or rot away much of the cellular tissues and pectin surrounding bast-fibre bundles, and so facilitating separation of the fibre from the stem.

B. Types Of Retting

- 1) *Water Retting:* It is performed by submerging bundles of stalks in water. The water, penetrating to the central stalk portion, swells the inner cells, bursting the outermost layer, thus increasing absorption of both moisture and decay-producing bacteria.
- 2) *Dew Retting:* It is effective in climates with heavy night time dews and warm daytime temperatures. The harvested plant stalks are spread evenly in grassy fields, where the combined action of bacteria, sun, air, and dew produces fermentation, dissolving much of the stem material surrounding the fibre bundles. Within two to three weeks, depending upon climatic conditions, the fibre can be separated.

C. Epoxy Lapox B-11 And Hardener K-6

B11-k6 LAPOX B-11 is an unmodified liquid epoxy resin of medium viscosity. It can be formulated into high strength adhesives, solvent free coatings and floor toppings. These formulations are generally used as room temperature curing systems in combination with aliphatic polyamines, polyamine adducts (both aliphatic and aromatic), phenalkamines and polyamides.

Hardener Lapox K-6 is a low viscosity room temperature curing aliphatic amine curing agent. It is commonly employed where low viscosity and fast setting at ambient temperature is desired. It is recommended for marble industry application like crack sealing, bonding of marbles, marble backing composition, and marble frame fittings etc.

D. Steps Involved In Fabrication Of Composites

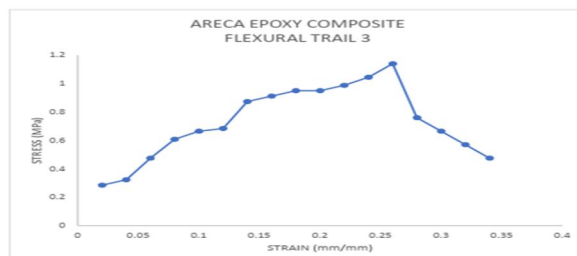
The composite laminates were prepared by the hand layup process. Unilateral areca and banana fibres were reinforced separately by placing layers between epoxy resin grade B-11 (3101) and the hardener grade K-6 (5205) was mixed in a ratio of 10:1. Stirring properly during the mixing and dispersing of resin and hardener into the matrix. □The unilateral areca fibre mat was kept on the epoxy resin film coating. The table was prepared using a plastic sheet and wax for easy removal. Then resin film coating was carried out with uniformity on the entire surface of the fibre mat. After that second layer of unilateral areca fibre mat was kept for the same dimensions and the epoxy resin was applied and fills over the entire surface of the fibre mat. The process was repeated until a thickness of 4 mm was obtained in the laminates. The air gaps were removed by using rollers. Then the laminated was compressed for a curing time of 24 hrs.

VI. EXPERIMENTAL STUDY

The mechanical properties are tested on the Areca/Epoxy and Banana/Epoxy composite, the tests are as follows,

- 1) *Tensile test-* In universal testing machine (UTM) the tensile test was carried out. Three samples were tested from each Areca/Epoxy and Banana/Epoxy composites. They were prepared in the dog bone shape or dumb bell shape according to the standards. It was carried out by clamping the specimen in the required fixture of the machine and load was applied until the specimen breaks.
- 2) *Flexural test-* It was carried out using UTM according to ASTM standard D790. Three samples were prepared for each composites. The deflection was measured under a compressive load until the specimen breaks or cracks. The top surface layer of the specimen was subjected to compression and the bottom surface layer of the same specimen was subjected to tension. The middle layer was subjected to shear.
- 3) Impact test is carried out in pendulum type impact test, the charpy test was conducted on both the composite samples. Three samples were tested. The specimen was placed on the fixture, as the notch facing to the opposite side of the striking edge. □The pendulum beam was placed at an angle of 1200 and was released to hit the specimen. The results obtained in joules

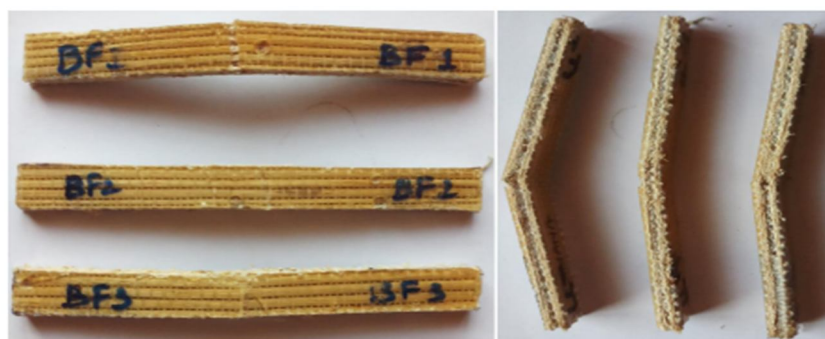
- 4) Scanning electron microscope (SEM) test is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the sample's surface topography and composition. The electron beam is scanned in a raster scan pattern, and the beam's position is combined with the detected signal to produce an image. SEM can achieve resolution better than 1 nanometre. Specimens can be observed in high vacuum in conventional SEM, or in low vacuum or wet conditions in variable pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments.



Stress-Strain for flexural properties of Areca Epoxy Composite trail

VII. RESULT AND DISCUSSION

At present the natural fibres have been used as reinforcement in polymer composites for varieties of applications in automotive components, structures and consumer goods. The main focus of this study is used to find out the mechanical properties like tensile, flexural and impact strength for natural fibre areca, and banana epoxy composite. The analysis of the surface of the tested samples is carried out by using scanning electron microscope (SEM).



Result Sample

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