Characterization of Epoxy Matrix Based Polymer Composite with Hair Filler

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Abstract: **Composite materials are perfect for structural applications that demand a high strength-to-weight ratio. Composite materials are cost-effective in weight-sensitive systems like aircraft and spacecraft. Manufacturing methods, anisotropy, elasticity, material strength, and micromechanics are all subjects included in the research of composite materials. The goal of this research is to investigate the possibilities of Human Hair fibre polymer composites and their mechanical characteristics. Human hair fibres were used as reinforcements in a polymer matrix in this study. This review aimed to provide information that would aid future study in this field. The effect of the source of Human Hair fibre on composite mechanical characteristics is discussed. Several natural fibre composites have achieved composite mechanical characteristics and are now in use, for example, in the furniture industry. Jute, flax, bagasse, and coir & hairs are now the most significant and affordable natural fibres. Human hair fibre composites look to have a promising future. So, a composite material is made by blending Human Hair fibre with epoxy araldite in proportions of 5%, 10%, and 15% of total specimen volume, and its strength is tested on UTM.**

Keywords — Human Hair, composites, testing

I. INTRODUCTION

The phrase composite material refers to the combination of two or more materials on a macroscopic scale to create a useful third substance. The macroscopic inspection of a material, in which the components can be recognised with the naked eye, is the key. Different materials can be mixed on a microscopic scale, such as in metal alloying, yet the final substance is macroscopically homogenous, in the sense that the components cannot be distinguished with the naked eye and fundamentally operate together. Two or more separate components are blended in composite material yet remain distinctly recognisable in the combination. Fiber glass/carbon fiber/coir fiber/sisal fiber/ground nut shell/hairs; one or two of these combined with a polymeric resin is arguably the most typical example. Human hair fibre is a newly researched usage in composites that will be examined experimentally in this study. While we cut the fibres and prepare the surface properly, we can easily discern between the fibres and the polymer resin when looking at the material. This is not the same as creating an alloy by combining two different materials until the separate components are indistinguishable. There are many composite materials, and while we may be aware of some, there are many more, ranging from the mundane, reinforced concrete (a mixture of steel rod and concrete, which is itself a composite of rock particles and cement), pneumatic tyres (steel wires in vulcanised rubber), many inexpensive plastic mouldings (polyurethane resin filled with ceramic particles such as chalk and talc), to the exotic metal matrix composites used in the space programme (metallic titanium alloys reinforced with (aluminium alloys loaded with wear resistant SiC particles). When the material is sectioned or fractured, the two [or more] constituent materials that make up the composite are always easily distinguishable, regardless of the actual composite.

Strength, fatigue life, stiffness, temperature-dependent behaviour, corrosion resistance, electric insulation, attractiveness, acoustic insulation, and low weight are some of the features that may be improved by constructing a composite material. Naturally, not all of these characteristics are enhanced at the same time, nor is it typically necessary. In reality, several of the qualities are mutually exclusive, such as thermal insulation and thermal conductivity. The goal is to build a material that only has the properties required to complete the design assignment. Composite materials have been used for a long time. Their exact origins are uncertain, however allusions to composite materials may be found throughout history. The Israelites, for example, employed straw to reinforce mud bricks. The ancient Egyptians utilised plywood after discovering that

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wood could be rearranged to obtain higher strength and resistance to temperature expansion as well as swelling induced by moisture absorption. In weight-sensitive applications such as aviation and space vehicles, fibre-reinforced, resin-matrix composite materials with high strength-to-weight and stiffness-to-weight ratios have lately become relevant.

II. PROBLEM STATEMENT

Steel and aluminium used worldwide is very hectic for transportation as its heavy and having much rusting issues so need alternative material to replace it, High Maintenance Costs And More Corrosion, Above materials availability is not sufficient, Moulding, casting, machining cost is high.

To overcome above difficulties and improve mechanical properties the new class of composite material is better alternative.

III. OBJECTIVES

1. To Fabricate new class of epoxy base composite material.

2. To characterized mechanical properties on UTM.

IV. METHODOLGY

1. The Fabrication of new class of epoxy based composite material by hand moulding

2. The characterisation of mechanical properties of newly fabricated composite material is performed by testing on UTM.

V. RESEARCH METHODOLGY

1. Saloon-collected human hair fibres

2. Epoxy mixture preparation: Araldite solution CY-230 with HY-951 hardener is utilised as epoxy (matrix) material. These two components are cooked in the oven and blended in the correct proportions. It will be transformed to a solid after cooling, and that solid will be utilised as an epoxy model for testing.

3. Epoxy Mould Preparation: Mold preparation is done with transparent acrylic sheet. A 2mm thick acrylic sheet was used. The plates are cut from the sheet to fit the mold's dimensions. For finishing, plates are sliced with certain tolerance. Plates are completed on all sides and made perpendicular. The feviquick is used to attach all of the sheets, and the box has one open side. The mould is thoroughly cleaned once the plates have been tightened. To prevent leaking, the wax or clay substance is applied in each joint. To pour the mixture, one side of the mould is left open. As a result, the mould is prepared and thoroughly inspected for leaks.

4. Epoxy Solution Preparation: To eliminate moisture and air bubbles, the CY-230 solution with the HY-951 hardener is separately heated in the oven for roughly 2 hours at a rate of 70 to 100 degrees. At room temperature, the heated solution is progressively cooled. The hardener HY-951 is gradually added to the CY-230 & HY-951 combination, with a weight ratio of 100:10.33. For good and thorough mixing, the mixture is swirled constantly in one direction. After stirring for around 20 minutes, the mixture is ready to pour into the mould. Exothermic reaction between araldite and hardener In the meantime, the acrylic mould is chemically cleaned. The slurry is then carefully poured into the mould to avoid the production of air bubbles. The mixture has entirely filled the mould. The mould is left in this configuration for 24 hours to cure at room temperature. When the hardener and resin solution has solidified, the solid produced may be readily withdrawn from the mould. As a result, a solid epoxy or matrix material model is created. The sculpture was left on a flat surface for four days to harden. It is put to the test after four days.

5. Specimen preparation: Araldite solution CY-230 with HY-951 hardener is utilised as an epoxy (matrix) material, and human hair (5%) by weight is employed to make composite material. CY-230 araldite solution with HY-951 hardener heated in oven, combined in suitable proportions, and put into mould. It will be turned to a solid after cooling, and that solid will be utilised as a composite material model for testing.

6. Material Composition After two days, the human hair epoxy composite is removed from the mould for tensile testing. It is left on a flat surface for four days to harden so that the hard specimen may be tested. The length and cross sectional area of a finished composite specimen are measured. The length of the centre line has been marked. On both sides, fifty mm markings are made from the centre line. The specimen is then attached to the universal testing machine. The length of the specimen is measured first in the Universal testing machine, then gradually loaded to notice deformation.

VI. PREPARATION

Two mould plates were obtained, and a template of 210*210 mm, the composite's size, was prepared inside their confines. The composite was created by gathering hair from diverse sources and manually rolling it into thin beds with interlaced follicles. Three such beds were built with around 20gms of hair each. After that, a clump of hair about 4 inches long was extracted, and tiny groups of follicles were separated, each of the same thickness, and arranged individually in a longitudinal pattern. A total of 50 strands were created. The epoxy resin was prepared using a 10:1 ratio of Araldite LY556 to HY951 hardener and well mixed.

VII. FABRICATION PROCESS

On the inside side of the template, a bit of the mixed resin was applied. Then, within the confines, one of the rolled beds was put and positioned exactly. The second coat of

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epoxy was put on top of it and spread uniformly using an MS roller gripped by a handle after it had dried for about 2 minutes. Then, roughly 25 of them were made into strands and laid longitudinally, uni-directionally on top of the resin at a 0 degree angle to the initial bed. The epoxy resin was then poured over the second bed and distributed uniformly with the MS roller. The third layer was then applied using the second bed, and the identical method was followed. The fourth layer was created by repeating the process with the third bed. The remaining strands were then layered on top as the final layer, with an orientation of 0 degrees in relation to the preceding layer of strands, and the remaining epoxy was poured on top. The top of the material was covered with another waxed gloss paper cut to the proportions of the mould plate. Then, at the vertices of the template, 4mm thick spacers were put to provide a non-tapered surface and consistent thickness throughout. This is where the top mould plate was positioned for sandwiching. The setup was then placed in a fixture and tightened completely until all of the excess epoxy had run out and a suitable setting had been achieved, after which it was left undisturbed for one day. The composite was withdrawn from the fixture, freed from the mould plates, the gloss paper was ripped, and the composite was made ready after verifying for appropriate curing. The weight of the composite was determined after it was cut into normal size. For various mechanical testing, five identical materials were created.

VIII. EXPERIMENTATION AND TESTING

Tensile Test: The samples will be tensile tested in line with ASTM D638 specifications. The samples will be shaped into dumbbells and then tested for tensile strength using a universal tensile testing equipment.

Composite Test: After two days, the hair epoxy composite from the mould is removed. It is left on a flat surface for four days to harden so that the hard specimen may be tested. The length and cross sectional area of a finished composite specimen are measured. The length of the centre line has been marked. On both sides, fifty mm markings are made from the centre line. The specimen is then attached to the universal testing machine. The length of the specimen is measured first in the Universal testing machine, then gradually loaded to notice deformation.

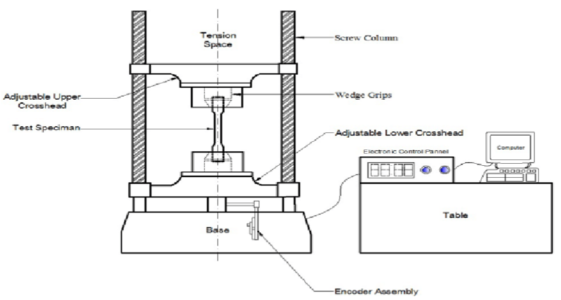

Fig 1 :Std tensile test set up [21]

CATEGORY (HAIR MIX OF WEIGHT)	WIDTH MM	THICKNESS MM	CROSS SECTION AREA MM2	LOAD-N	TENSILE STRENGTH MPa
5%	8.15	6.2	50.53	2230	39.11
10%	8.15	6.2	50.53	2487	42.17
15%	8.15	6.2	50.53	2178	36.90

Table 1 : Result of Tensile Tests

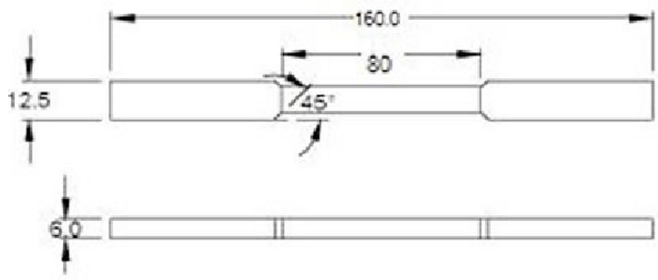

Fig.2. Standard specimens for Tensile test

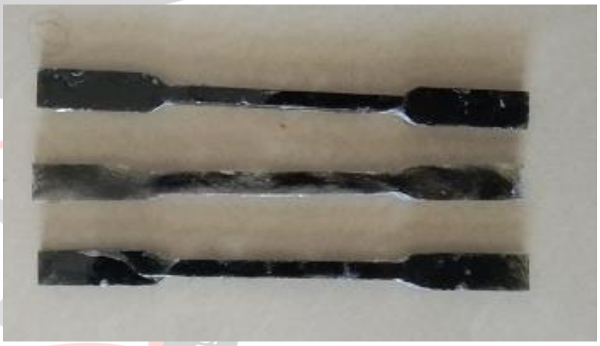

Fig .3 Actual specimens

IX. CONCLUSION

Polymer composites made from hair. Hair composites are made and their mechanical characteristics are examined in this study. A step ahead is to use waste material technically and improve the qualities of various current materials so that they can be more useful and have advanced properties than they are now. The following are the results of the experimental inquiry. The highest tensile strength of 42.17 MPa was obtained in a 10% hair mix composite, compared to 39.11 MPa in a 5% hair mix composite and 36.90 MPa in a 15% hair mix composite as covered in P Divakar Rao Paper [21] Overall, hair composites have equal strength to aluminum and steel nearby, so they may partially replace steel and aluminum applications to benefit from low weight, simple transportation and handling, and no rusting difficulties in terms of mechanical qualities.

X. FUTURE SCOPE

Currently, only car bumpers and door handles are made of composite materials, but in the future, more and more parts, such as leaf springs, seats, steering, and propeller shafts,

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will be built of composite materials, minimising the usage of heavy and rust able steel and aluminium.

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