

Analysing the Mechanical Behaviour of Natural Waste Fiber Reinforced Composite by Using Degradable Resin

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ABSTRACT: Composite material is made from composition of two or more material with unique physical, chemical and mechanical properties, binding collectively to produce a new material. Nowadays plastic pollution is the essential risk to our day to day life. Hence authorities banned plastic items and non-biodegradable items and advocated the use of eco-friendly products. Nowadays many researchers are planning to recycle the waste material into a composite material. While recycling the waste material into a composite material the fee the product has been reduced. Composite materials are designed due to its light weight, high strength, non-conductive, corrosive resistance, durable. In this work an effort is taken to prepare ecofriendly degradable Composite material by using the natural waste materials like banana flower fiber, pomegranate shell and coconut shell powder binding with recyclable degradable resin.

1. INTRODUCTION

Plastics and other non-biodegradable items is the major reason we going for alternatives such composite materials. Composite materials has been produced by binding two or more different materials with different composition. Natural Fiber Reinforced Composites (NFRC) is a composite material which consists of polymer matrix embedded with high-strength natural fibers. Natural fibers are produced by plants, animals, and geological processes. [1-2]

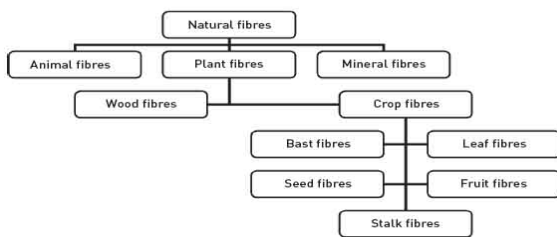


Fig-1-Types of natural fibres

They can be used as a factor of composite materials. In this waste materials are chosen as natural fiber. In 1960's plastics have been end up widely used. [3-4] Nowadays many researchers advised to boost alternatives. The "Natural Fiber Reinforced Composite Material" is revolutionary to boost and they are broadly used in enterprise because of their low density and ecofriendly. [5, 6] In today's world, natural waste materials is used in all fields of industry and it also used for waste water treatment. In development field, bricks are organized from waste material. [7, 8]

2. EXPERIMENTAL PROCEDURE

The waste materials used are coconut shell powder, pomegranate peel powder and banana flower powder are used for producing composite materials. Because of the usage of the natural waste material the price of the products can be reduced.[1-4] In addition with that we can minimize the air, water and land pollution. Recycling the waste material saves surroundings and reduces solid waste. Our target is to endorse the natural fiber composite material instead of plastic and non-biodegradable items. Material thus received which involves the following test (Tensile, Hardness, Moisture test) in addition the material has been analyzed.

1.1 Methodology

In this research we fabricated three sample by varying the percentage of weight of pomegranate shell powder and banana flower fiber powder with the coconut shell powder is shown in the table-1. The method of making product is shown in the fig-1 as a flow chart.

Manuscript published on 28 February 2019.

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Table-1-Weight Percentage of Reinforcing Powder with Coconut shell powder

| Samples | Coconut shell powder in Grams | Pomegranate shell Powder in grams | Banana flower Powder in grams | Total Weight of the Product in grams |
|----------|-------------------------------|-----------------------------------|-------------------------------|--------------------------------------|
| Sample-1 | 200 | 40 | 10 | 250 |
| Sample-2 | 200 | 35 | 15 | 250 |
| Sample-3 | 200 | 30 | 20 | 250 |

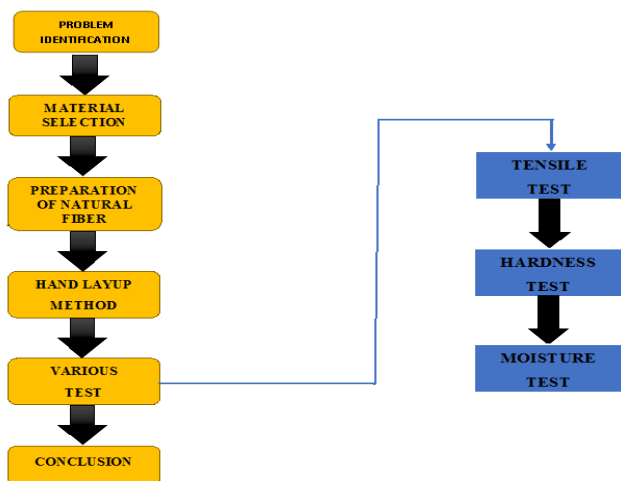


Fig-2-Fabricating Methodology

2.2 Coconut Shell Powder

Coconut shell powders are biodegradable and ecofriendly as shown in the fig-3. Experiments on pyrolysis Coconut shell powder stand up to temperature in the range 450°C-600°C. Coconut shell powder is low cost, renewable, high specific strength to weight ratio, low density and environmental friendly.



Fig-3-Coconut Shell Powder

2.3 Pomegranate Peel

Pomegranate peel powder is used as an antioxidant and it is additionally has high tensile strength. The fruit is berry like with a leathery rind (husk or peel) enclosing many seeds surrounded by way of juicy arils. The husk is composed of two parts: pericarp and mesocarp (albedo). The Pomegranate peel layer dried in the sunlight in the normal atmospheric temperature ranging 27-30°C is shown in the fig-4.



Fig-4-Pomegranate Peel

2.4 Banana Flower

The properties and the actual physical structure of the banana flower fibers are shown in the table-2 and fig-5.

Table-2-Properties of Banana Fibre

| | |
|---------------|--------|
| Cellulose | 31-35% |
| Hemicellulose | 14-17% |
| Lignin | 15-16% |



Fig-5-Banana Flower

2.5 Resin

Resin is an organic substance which is insoluble in water and used as a glue for making components.

Types of Resin

There are three main types of resin are used. They are:

- ❖ Polyester
- ❖ Epoxy
- ❖ Polyurethane
- ❖ Silicone

Epoxy resin is used because among these four resin Epoxy is the strongest resin. And these resin used mostly in all fields of industries.

3. RESULTS & DISCUSSIONS

Araldite LY 556 Epoxy resin is taken for fiber reinforcement because it has low shrinkage, Strong mechanical properties, Resistance to corrosive liquids and environment, Superior electrical properties, good performance at elevated temperatures.

Hardener HY 917 is used as a curing agent, it solidify the mixture of resin and fiber.

Epoxy resin is mixed with natural fiber in the ratio of 1:1. And the Hardener mixed in the ratio of range 1:10.

Performance properties held by epoxy are:

- Environmentally friendly
- Flame resistant
- Food Grade

3.1 Mechanical properties:

- Tensile strength 85 N/mm²
- Elongation at break 0.8%
- Compressive Strength 190 N/mm²
- Water absorption - 24 hours at 23°C

The product prepared by making a die which consists of the dimensions mention in the fig-7 and as per the dimension the final product shown in the fig-6 has been made successfully.



Fig-6-Final Product

1. Diameter: 50 mm
2. Height: 45 mm
3. Ratio Of Resin and Fiber mixed in the range 1:1
4. Resin: Araldite LY 556 Epoxy
5. Hardener: Hardener HY 917

Fig-7-Final Product-Dimensions

3.2 Experimental Test Analysis and Results

After making the composite material, Physical and mechanical properties are analyzed by using the following material testing methods mentioned below.

- ❖ Tensile test

- ❖ Hardness test
- ❖ Moisture test

3.3. Tensile Test

- ❖ Tensile test is also known as tension testing. It is the fundamental engineering test, in which the material is subjected to tension until failure.
- ❖ By this testing, ultimate tensile strength, breaking strength, Maximum elongation and reduction in area can be determined and the values are given in the table-3 and variation is shown in the fig-8.

Table-3-Tensile Test

| Test Parameters | Sample-1 | Sample-2 | Sample-3 |
|----------------------------------|----------|----------|----------|
| Ultimate Tensile Strength in Mpa | 20 | 20.24 | 21 |
| Ultimate Tensile load in KN | 4.16 | 4.36 | 4.54 |

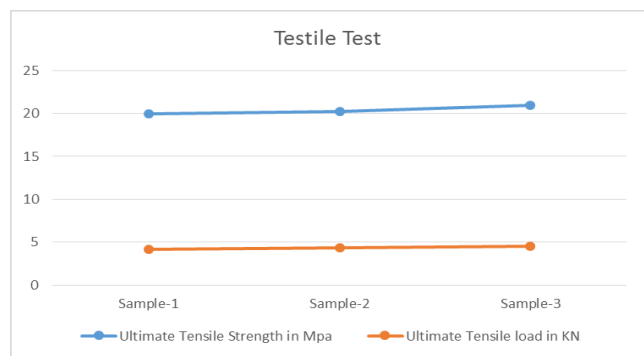


Fig-8-Tensile Test

3.4 Hardness Test

- ❖ Hardness test is defined as the resistance to indentation and is determined by measuring the depth of the indentation as shown in the fig-8.
- ❖ Rockwell hardness method is widely used.
- ❖ This method is more accurate than other test methods and also it is easier to perform than methods and results are shown in the table-4 and fig-9.



Fig-9-Hardness Testing Machine

Table-4-Tensile Test

| Test Parameters | Sample-1 | Sample-2 | Sample-3 |
|-----------------|----------|----------|----------|
| Hardness HRC | 36 | 37 | 37 |



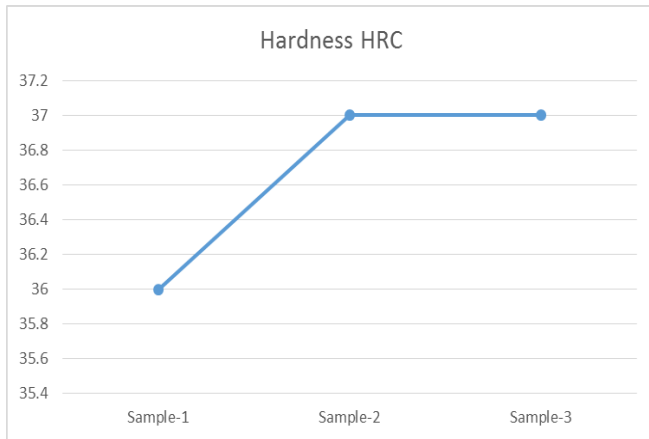


Fig-9-Tensile Test

3.5 Moisture Test

- This test is done to check how long the specimen resisting in normal and hard water shown in the fig-10.
- Moisture test is done manually in the laboratory.
- And the result is determined that after 4 days continuous observations in normal and hard water there is no change in size and shape as well as in weight perspective in the room temperature.

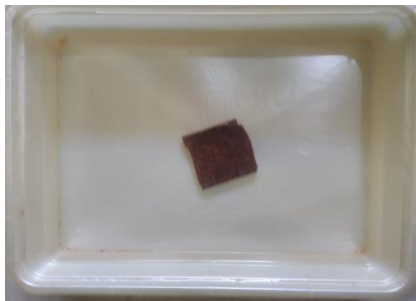


Fig-10-Moisture Test

4. CONCLUSION

An effort is taken to recycle the natural waste and avoid the plastic in connection to protect our mother of earth by preparing the Natural waste reinforced composite product and we got positive results according to tests we done. The Prepared Nature Fiber Reinforced Material Specimen and the Product meets the demand by the results which is found through the hardness, tensile and moisture content test. This product can replace the plastic product and also the cost of the product is also very economic and it can be reused.

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