DESIGN AND DEVELOPMENT OF COMPOSITE BASED ON THE ROSELLE FIBRE

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ABSTRACT

In this project, fabricate the natural fiber composite materials by using polyester and epoxy resin with different weight ratio of Roselle fiber and fiber length were prepared. Then they were analysis their mechanical properties such as tensile strength, flexural strength, compressive strength, and impact strength for different aspect ratio of fiber.

KEY WORDS:

Roselle fiber, epoxy resin, mechanical properties

INTRODUCTION:

Roselle is a short-day plant and photoperiodic. Unlike kenaf, roselle crops cannot be grown successively throughout the year. If intended solely for the production of calyces, the ideal planting time in southern Florida is mid-May. Blooming will occur in September and October and calyces will be ready to harvest in November and December. Harvesting causes latent buds to develop and extends the flowering life of the plant to late February. When the fruit is not gathered but left to mature, the plants will die in January.

Rolfs recommended whatever fertilizer would be ordinarily used for vegetables but warned that only 1/4 to 1/2 the usual amount should be applied. He wryly remarked: "As a whole, the plants are rather more vigorous than need be; consequently no attention need be paid in the direction of vigor." An excess of ammonia encourages vegetative growth and reduces fruit production. Commercial fertilizer of the formula 4-6-7 NPK has proved satisfactory. Weeding is necessary at first, but after the plants reach 1 1/2 to 2 ft (45-60 cm) in height, weeds will be shaded out and no longer a problem. Early pruning will increase branching and development of more flowering shoots.

Figure1. Roselle, Hibiscus sabdariffa

MATERIALS AND METHODS:

Table 1. Weaving particulars

Property	Roselle
Diameter (micrometer)	100 to 300
Density (gms /cc)	1.650
Elongation at break (%)	6 to 10
Tensile strength (MPa)	385
Young's modulus (MPa)	13150

Roselle Fiber is extracted from stem of the Roselle plant. Fig shows the extraction method of Roselle fibers. Cut the Roselle plants and the stalk were tied into bundles and retted in water for 5–8 days. The retted stem of the Roselle plant was washed in running water. Then the fibers were removed from stem, cleaned and dried using the sunlight.

Roselle material is extremely harsh in feel and finds difficulty in mechanical processing. A softening treatment is necessary to make the roselle easily processable. For this softening treatment non-ionic softener such as Ceranine PE is used. The process is carried for one hour and it is taken out and dried.

In this project, we have planned to produce the composites using compression molding technique. In order to produce the composites there are different types of laying technique available.

Table 2. Properties of Polyester resin

Property	polyester Resin
Appearance	Pale yellow colour
Viscosity(cps)	650
Density(gms/cc)	1.15
Elongation at break (%)	4.8
Tensile strength(MPa)	41
Young's modulus(MPa)	968
Flexural strength(MPa)	61
Flexural Modulus(MPa)	2461

Table no 3. Compression molding machine requirements

Fiber Materials	Roselle fiber
Resin	Resin (polyester, epoxy)
Blend proportion	60/40,70/30,80/20
Temperature	155,165 C

Duration	4 Min,6 Min
Pressure	15, 8 bar
Composite production method	Fiber reinforced composites

TENSILE TEST:

One of the most common testing methods, tensile testing, is used to determine the behavior of a sample while an axial stretching load is applied. These types of tests may be performed under ambient or controlled (heating or cooling) conditions to determine the tensile properties of a material. Tensile testing is performed on a variety of materials including metals, plastics, elastomers, paper, composites, rubbers, fabrics, adhesives. Tensile testing is commonly used to determine the maximum load (tensile strength) that a material or a product can withstand. Tensile testing may be based on a load value or elongation value.

Fix the Sample in between two jaws and bottom jaw is movable one. After the sample is fixed the bottom jaw is moving at the principle of constant rate of loading (CRL). The tensile tester shows the data in Breaking Load in Newton and Elongation at Break.

Sample Size: The sample size for testing the tensile strength is following, Length - 150 mm, Width – 12 mm

IMPACT TEST:

The test is performed based on the ASTM STP 936 1985-08 in the charpy impact strength tester. According to the procedure, the sample is placed on the sample holder and hammer will be swinged by our hand. The hammer strikes and breaks the specimen and the amount of energy required to break the sample is read from the dial in the instrument. The impact strength testing machine shows the data in Joules. The samples required for performing impact strength must have the following dimensions: Length -65 mm, Width - 12 mm

FLEXURAL TEST:

A flexure test produces tensile stress in the convex side of the specimen and compression stress in the concave side. This creates an area of shear stress along the midline. To ensure the primary failure comes from tensile or compression stress the shear stress must be minimized. Flexure testing is often done on relatively flexible materials such as polymers, wood and composites. There are two test types; 3-point flex and 4-point flex. In a 3-point test the area of uniform stress is quite small and concentrated under the center loading point. In a 4-point test, the area of uniform stress exists between the inner span loading points (typically half the outer span length).

Figure 2. Roselle composites board samples

RESULT AND DISCUSSION:

Table 4. Result for Tensile strength of composites

S.NO	SAMPLE	PROPORTION	MAXIMUM LOAD IN N
1	PE1	60/40	1507.53
2	PE2	70/30	1535.38
3	PE3	80/20	1082.02
4	EP1	60/40	846.45
5	EP2	70/30	989.13
6	EP3	80/20	614.25

Table 5. Results for Impact Strength of Composites

S.NO	SAMPLE	PROPORTION	IMPACT STRENGTH IN JOULES
1	PE1	60/40	00.523
2	PE2	70/30	00.823
3	PE3	80/20	1.007
4	EP1	60/40	00.798
5	EP2	70/30	00.485
6	EP3	80/20	00.965

Table 6. Results for Flexural Strength of Composites

S.NO	SAMPLE	PROPORTION	FLEXURAL STRENGTH IN Kg/cm²
1	PE1	60/40	2.387
2	PE2	70/30	5.437
3	PE3	80/20	3.986
4	EP1	60/40	4.857
5	EP2	70/30	7.543
6	EP3	80/20	6.295

Table 7. Results for Compression Strength of Composites

S.NO	SAMPLE	PROPORTION	MAXIMUM LOAD IN N
1	PE1	60/40	63.55
2	PE2	70/30	91.43
3	PE3	80/20	73.61
4	EP1	60/40	73.59
5	EP2	70/30	96.43
6	EP3	80/20	80.42

Table 8. Mechanical properties of various natural fiber

Fiber Type	Density (kg/m3)	Water Absorption (%)	Modulus Elasticity E(GPa)	Tensile Strength (MPa)
Roselle	750- 800	40-50	10-17	170-350
Date Palm	463	60-65	70	125-200
Coconut	145-380	130-180	19-26	120-200
Reed	490	100	37	70-140
Sisal	700 - 800	56	10-30	268-500
Jute	1450	70	20	533
Elephant grass	817.53	80	7-15	185

CONCLUSION:

- The aim of this project to fabricate a suitable alternative material for wood products and plastic products which is an economically available alternative and should be easy to fabricate.
- The natural composite materials are very less in weight compare to other materials like wood, plastics etc.
- In this project, fabricate the natural fiber composite materials by using polyester and epoxy resin with different weight ratio of fiber and fiber length were prepared. Then they were analysis their mechanical properties such as tensile strength, flexural strength, compressive strength, and impact strength for different aspect ratio of fiber.
- When the mechanical properties are observed, they are compared with properties like plastics materials, wood and other natural fibers etc and also analyze the properties.
- We expect that the experimental values of mechanical properties of roselle composites are more than the other natural fibers that we had mentioned in above literature survey.

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