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Fabrication and Analysis of Natural Fibres Reinforced Composite Material

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ABSTRACT:

Bio composite materials are synthesized using natural cellulose fibers as reinforcements together with matrix, which have attracted the attention of researchers due to their low density with high specific mechanical strengths, availability, renewability, degradable and being environmental-friendly. The bio-composite are prepared with the unsaturated polyester matrix and fibers such as jute, sisal, coconut, areca using compression molding process with appropriate proportions. The fabricated composite material are planned to evaluate its mechanical properties such as tensile strength, impact strength, water absorption and compression strength.

Keywords: Natural fibers, Epoxy resin, compression molding, Analysis.

INTRODUCTION:

Composites are combinations of two or more than two materials in which one of the materials, is reinforcing phase (fibers, sheets or particles) and the other is matrix phase (polymer, metal or ceramic). Composite materials are usually classified by type of reinforcement such as polymer composites, cement and metal- matrix composites. Natural fiber composites possess the advantages such as easy availability, renewability of raw materials, low cost, light weight and high specific strength, and stiffness. It is expected that in the near future biodegradable polymers will replace synthetic polymers. In the present study, an attempt has been made to reinforce, epoxy resin matrix with multiple natural fibers and to characterize its mechanical performances to evaluate their suitability for properties and applications.

COMPONENTS USED:

- Natural fibers (sisal, jute, coir, areca)
- Epoxy resin (LY-556)
- Hardener (HY-951)
- NaOH solution

NATURAL FIBERS:

SISAL FIBER:

Sisal fiber is one of the most used widely used natural fibers and is very easily cultivated. It obtained from sisal plant. Known formally agave sisal Ana. Each leaves contains a number of long straight fibers which can removed the pulp and plant material. It's used twine and textile productions make paper products. its traditionally used for rope and twine, and has many others, including paper, cloths,

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footwear, hates, bags, carpets, and dartboards. Sisal fiber has been the leading material for agriculture twine. Because of its strength, durability, ability to stretch, affinity certain dyestuffs.

2.JUTE FIBER:

Jute is a bast fiber used for sacking, burlap, and twine as a backing material for tufed carpets. Its along, soft, shiny fiber that can be spun into coarse, strong threads. It is one of the cheapest natural fibers, and is second only to cotton in amount to produced and verity of users. Jute mates are composed primarily of the plant material cellulose, lignin, and pectin. Both the fiber and plant from which its comes are commonly called jute. it belongs to the genus corchorus in the basswood family, tiliaceae. It has high tensile strength and low extensibility and ensures better breathability of fabrics. Therefore jute is very suitability in agricultural commodity bulk packaging. Jute is one of the most versatile natural fibers.

3. COCONUT COIR FIBER:

Coconut fiber is extracted from the outer shell of a coconut. It is the natural fiber of the coconut husk where it is a thick and coarse but durable fiber. The common name, scientific name and plant family of coconut fiber is coir, cocos nucifera and arecaceae respectively. The cost of the coir fiber is less. Compared to other natural fibers, there are two types of natural fibers. Brown fibers extracted from matured coconuts and white fibers extracted from immature fibers. Brown fibers are thick, stong and absorption resistance, white fibers are smother and fine, but also stronger. Both white and brown consist of fibers ranging in length from 4-12. Those that are at at least 8 in 20cm long are called bristle fibers.

4. ARECA FIBER:

The natural fibers-reinforcing material areca appears to be a promising material because it inexpensive, availability, is abundant and a very high potential perennial corp. it belongs to the species areca catechu. Under the family palamecea and originated in the Malaya peninsular east india. Its has high strength and easily availability and low cost natural fiber. These fibers exhibits better tensile strength and flexural strength. These fibers are despite their low strength and lead to composite with specific strength because of their low density. These natural fibers are nontoxic and eco-friendly and biodegradable and are quite cheap. Scientific data of yhe structure and properties of the fibers are readily available. Its available renewable resources.

EPOXY RESIN (LY-556)

- Light weight
- Resists most alkalis and acids
- Resists stress cracking
- Retains stiffness and flexibility
- Low moisture absorption
- Non-staining
- Easily-fabricated

HARDENER (HY-951)

Hardener is a curing agent for epoxy or fiberglass. Epoxy resin requires a hardener to initiate curing. it is also called as catalyst, the substance that hardens the adhesive when mixed with resin. It is the specific selection and combination of the epoxy and hardener components that determines the final characteristics and suitability of the epoxy coating for given environment.

NaOH SOLUTION:

Sodium Hydroxide (NaOH) is a alkaline solution used to enhance the surface morphology of natural fibers.

FABRICATION PROCEDURE BY COMPRESSION MOULDING PROCESS:

The suitable work table is fixed. which should be smooth and clean. The required amount fiber mat was taken. Then the fiber mat was cut according to the required size. The required amount of the epoxy resin was taken. Then the hardener was mixed in the proportion of 20 to30 ml per kg of epoxy resin. The catalyst was used for the quick drying of the mixture. Then the resin was applied on the surface of the mould by using a brush. Then the natural fiber was placed on the resin. Again the resin was applied on the surface of the fiber. Then the natural fibers was mixed(sisal+jute) in a different composition and placed on the resin into the mould. Again the mould was placed over the table. Finally the force is applied by using

compression moulding machine on the surface of the mould. Then the fabricated material was dried in the presence of sun light and atmosphere. Similarly, the same working procedure was repeated for the other specimen composition. sisal fiber, jute fiber and areca fiber were placed between the mould instead of resin and hardener. The fabricated specimens were dried in the presence of sun light and the atmosphere up to more than two and three days.

FABRICATED COMPOSITE PLATES:

TO ANALYZE THE MECHANICAL PROPERTIES WE HAVE CONDUCTED FOUR TESTS FOR OUR SPECIMENS.

- Tensile test
- compression test
- impact test
- water absorption test.

TENSILE TEST:

- It is one of the most widely used mechanical tests.
- A tensile test helps determining tensile properties such as tensile strength, yield point or yield strength, % elongation, % reduction in area and modulus of elasticity.
- Since mechanical properties to some extent are influenced by the size and the shape of the test specimen, it is customary to use standardized specimen.
- Tensile test is carried out by gripping the ends E, E of the specimen in a tensile testing machine, fig a, and applying and increasing pull on the specimen till it fractures.

IMPACT TEST:

- Impact testing becomes essential in order to study the behavior of materials under dynamic loading.
- An impact test determines the behavior of materials when subjected to high rates of loading ,usually in bending, tension or torsion
- In impact test, a specimen, machined or surface ground and usually notched, is struck and broken by a single blow in a specially designed testing machine. The quantity measured is the energy absorbed in breaking the specimen by a single blow.
- The ideal impact test would be one in which all energy of a blow is transmitted to the test specimen.

COMPRESSION TEST:

- Compression test is normally conducted to obtain the mechanical properties of the fibers. It is the primary test used for the quality control and the basis for acceptance and refusal of composite products used in automobiles and other uses.

- Friction between machine head and the sample effects the results causing stresses to have a small inclinations.
- Using small samples results in inaccuracies in results and using large samples requires testing machines with large capacities.

TABLE 1.

RESULT OF TENSILE TEST:

	CS Area [mm_2]	Peak load [N]	% of Elogation	Break load [N]	UTS [N/mm^2]
Min	75.000	1495.407	0.990	0.000	19.944
Max	75.000	2648.160	2-670	2118.940	35.306
Avg	75.000	1977.674	1.189	930.908	26.369
Std Dev.	0.000	370.789	0.631	908.527	4.924
Variance	0.000	137491.348	0.376	825421.947	24.421
Median	75.000	2030.789	1.740	913.130	27.076

TABLE 2.

RESULTS OF COMPRESSION TEST

	CS Area [mm_2]	Peak load [N]	Break load [N]	Compressive Strenght [N/mm^2]
Min	75.000	2757.826	1.315	36.768
Max	75.000	3715.577	9.545	49.541
Avg	75.000	3233.021	4.762	43.106

Std Dev.	0.000	331.809	2.332	4.424
Variance	0.000	110097.204	5.438	19.570
Median	75.000	3143.879	4.679	41.918

TABLE 3.

RESULTS OF IMPACT TEST

Sample ID	Izod Impact Values in J for 3 mm thickness
1	0.90
2	0.60
3	0.60
4	0.25
5	0.25
6	0.35
7	0.55
8	0.30
9	0.50

TABLE 4.

RESULTS OF WATER ABSORPTION TEST

Sample No	Weight before test in gms	Weight after test in gms (48 hrs)	% of weight absorption
1	1.67	1.73	3.6
2	1.55	1.62	4.5
3	1.56	1.63	4.5
4	2.12	2.23	5.2

5	1.83	1.92	4.9
6	2.2	2.31	5.0
7	1.27	1.35	6.3
8	1.13	1.21	7.1
9	1.19	1.26	5.9

CONCLUSION

The fiber reinforced composite material was fabricated and then its mechanical properties like tensile, impact strength compression test and water absorption was determined. The result thus obtained was compared with each specimen. It was proved that the added additives of natural fibers like sisal fiber, jute fiber in a composite material gives poor tensile strength when compared to the standard specimen. But the additives in composite material gives high tensile strength. Through this type of works we are optimizing and suggesting that used as additives gives excellent mechanical tensile strength. But this is not in the case of impact strength. Impact strength of all the specimens has almost same values and also equivalent values to the standard specimen (A). In addition to that these materials have advantage like less weight, high strength, very cheaper, very easy to fabricate and eco friendly. Therefore mixed composite materials is used in the area where high strength is needed. In future we will deeply analysis the other mechanical properties of fiber reinforced composite material.

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