Vol 3 Issue 10 July 2014

ISSN No : 2249-894X

Monthly Multidisciplinary Research Journal

Review Of Research Journal

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RNI MAHMUL/2011/38595 **ISSN No.2249-894X**

Review Of Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

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Review Of Research
Vol. 3 | Issue. 10 | July. 2014
Impact Factor : 2.1002 (UIF)
ISSN:-2249-894X
Available online at www.lbp.world

ORIGINAL ARTICLE

FABRICATION AND TESTING OF COMPOSITE MATERIALS BY USING NATURAL FIBRES

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Abstract:

From last three decades materials which are mixture of two or more materials are in demand. The applications of such materials have grown up many folds Such composite materials are very helpful in engineering manufacturing. These materials are weight saving and cost effective. A good quality materials can be formed by using natural fibres. Such materials have high strength and low weight as compared to other conventional materials. These materials have good thermal and insulation properties. Such composites are widely used now a days in interiors of car windows, dash board etc. Number of properties of different materials can be induced into a single composite materials. Future of such materials is very bright.

KEYWORDS:

Fabrication and Testing , Natural Fibres , engineering manufacturing.

INTRODUCTION

Composite materials are man-made materials which are manufactured with an aim of replacing the conventional materials by overcoming their disadvantages. A composite material has two main constituents namely, matrix and reinforcements. The reinforcements or fibers are the main load carrying elements and it provides strength and rigidity to composite whereas, matrix gives the shape to composite, maintains fiber alignment and protects them against the environmental and possible damage.

Composite materials are broadly classified into three types based on the matrices namely,
1. Polymer matrix composites (PMC)
2. Metal matrix composites (MMC) and
3. Ceramic matrix composites (CMC)

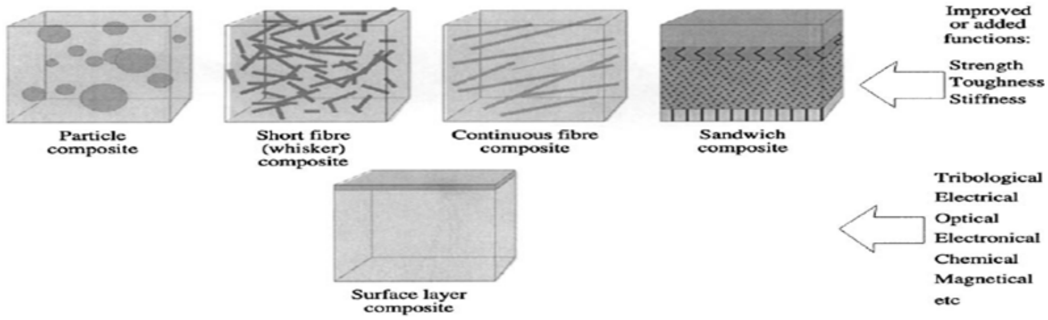


Figure1 Different types of composites

Composites made by using natural reinforcements are called as Natural Fiber Reinforced Plastics (NFRP). Bio-fibers like jute, sisal, vetiver, hemp, bamboo, etc are abundantly available at a reasonable cost. These natural fibers when used as reinforcements in composites provide very good mechanical properties and they are free from environmental hazards. The research in the field of bio-fibers made huge changes to make it superior to commercially available synthetic fibers. When these natural composites are made in the form of structural components like, aircraft cabins, landing gear doors, floorings, etc. they involve several machining operations like drilling, milling, slotting and surface finishing.

Machining operations cause damages on the workpieces and tools due to developed forces and other machining parameters. These damages and involved forces must be reduced in order to improve the machinability. Increasing the machinability is an important issue for manufacturing concerns in order to reduce the cost, time and labour. Hence a study on machining associated failures in composites will helps the composite industries to appropriately select optimum machining conditions and optimum selection of composite constituents for improved machinability.

Present Work

In the present project, new hybrid composites was developed by using two types of reinforcements namely,

1. Natural banana fibers, and
2. Synthetic glass fiber.

(a) Glass Fibre Sheet **(b) Banana Fibre**

Figure 2 Fibers used in experiment

Raw materials used for this experimental work are:

1. Natural fiber (Banana fiber)
2. Glass Fiber (E Glass)
3. Matrix - Polyester Resin (As per volume fraction)
4. Accelerator-Methyl ethyl ketone (2%)
5. Catalyst - Cobalt (1%)
6. Separator -Polyvinyl (2%)

Process of Fabrication
Wet/Hand Lay-Up:

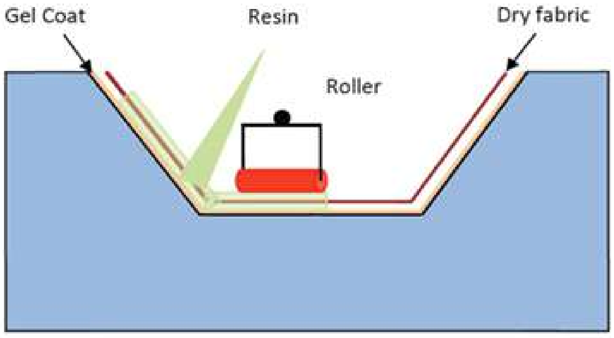


Figure 3 Wet hand lay – up process

The fibers are first put in place in the mould. The fibers can be in the form of woven, knitted, stitched or bonded fabrics. Then the resin is impregnated. The impregnation of resin is done by using rollers, brushes or a nip-roller type impregnator. The impregnation helps in forcing the resin inside the fabric.

The laminate so produced is then kept under a static load for 24 hours .The laminates fabricated by this process are then cured under standard atmospheric conditions. The materials that can be used have, in general, no restrictions. One can use combination of resins like epoxy, polyester, vinyl ester, phenolic and any fiber material.

Figure 4 Fabrication of fiber material

ADVANTAGES:

- The process results in low cost tooling with the use of room-temperature cure resins.
- The process is simple to use.
- Any combination of fibers and matrix materials are used.
- Higher fiber contents and longer fibers as compared to other processes.

DISADVANTAGES:

- Since the process is worked by hands, there are safety and hazard considerations.
- The resin needs to be less viscous so that it can be easily worked by hands.
- The quality of the final product is highly skill dependent of the labours.
- Uniform distribution of resin inside the fabric is not possible. It leads to voids in the laminates.

Figure 6 Glass and Banana fibre

TESTING OF FIBERS

1. Study of Hybrid composite (banana and glass fiber based epoxy composites).
2. Evaluate the mechanical properties such as impact strength, tensile strength, flexural strength.
3. Calculate the hardness of fabricated composite and to make a comparative analysis between the samples.
4. To conclude that the natural fiber reinforced composites behaves good considering mechanical performance.

TENSILE TESTING

A tensile test, also known as tension test, is probably the most fundamental type of mechanical test. By pulling on something, we will very quickly determine how the material will react to forces being applied in tension. As the material is being pulled, you will find its strength along with how much it will elongate. As we continue to pull on the material until it breaks, we will obtain a good, complete tensile profile. A curve will result showing how it reacted to the forces being applied. The point of failure is of much interest and is typically called its "Ultimate Strength" or UTS on the chart.

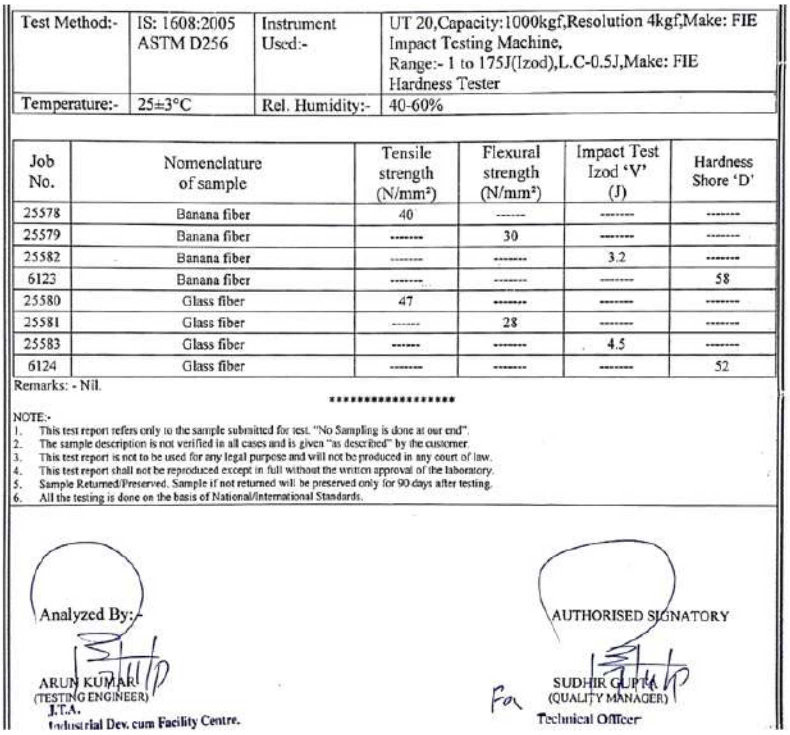
BENDING TESTING

The flexure test method measures behavior of materials subjected to simple beam loading. It is also called a transverse beam test with some materials. Maximum fiber stress and maximum strain are calculated for increments of load. Results are plotted in a stress-strain diagram. Flexural strength is defined as the maximum stress in the outermost fiber. This is calculated at the surface of the specimen on the convex or tension side. Flexural modulus is calculated from the slope of the stress vs. deflection curve. If the curve has no linear region, a secant line is fitted to the curve to determine slope.

IMPACT TESTING

Izod impact testing is a method of determining the impact resistance of composites. In impact test, an arm held at a specific height is released during the testing. The arm impacted on the sample and breaks the sample. Its impact energy is obtained from the energy absorbed by the composite or sample.

ACTUAL RESULTS



Test Method:-	IS: 1608:2005 ASTM D256	Instrument Used:-	UT 20,Capacity:1000kgf,Resolution 4kgf,Make: FIE Impact Testing Machine, Range:- 1 to 175J(Izod),L.C-0.5J,Make: FIE Hardness Tester
Temperature:-	25±3°C	Rel. Humidity:-	40-60%

Job No.	Nomenclature of sample	Tensile strength (N/mm²)	Flexural strength (N/mm²)	Impact Test Izod 'V' (J)	Hardness Shore 'D'
25578	Banana fiber	40	------	-------	-------
25579	Banana fiber	-------	30	-------	-------
25582	Banana fiber	-------	-------	3.2	-------
6123	Banana fiber	-------	-------	-------	58
25580	Glass fiber	47	-------	-------	-------
25581	Glass fiber	------	28	-------	-------
25583	Glass fiber	------	-------	4.5	-------
6124	Glass fiber	-------	-------	-------	52

Remarks: - Nil.

****

NOTE:-
1. This test report refers only to the sample submitted for test. "No Sampling is done at our end".
2. The sample description is not verified in all cases and is given "as described" by the customer.
3. This test report is not to be used for any legal purpose and will not be produced in any court of law.
4. This test report shall not be reproduced except in full without the written approval of the laboratory.
5. Sample Returned/Preserved. Sample if not returned will be preserved only for 90 days after testing.
6. All the testing is done on the basis of National/International Standards.

Analyzed By:-
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Industrial Dev. cum Facility Centre.

AUTHORISED SIGNATORY
For SUDHIR GUPTA
(QUALITY MANAGER)
Technical Officer

CONCLUSIONS

The results indicate that adding banana fibre to glass fibre and make a hand lay up composite of the natural and synthetic fibre results in a composite with a higher flexure strength but on the other hand it reduces the tensile strength. It is also observed that the impact strength when measured by Izod charpy came out to be less in composite so formed as compared to the glass fibre only composite .Whereas, the hardness showed a slight improvement in the sample.

FUTURE SCOPE

Due to low density and satisfactorily high specific properties of natural fibers, the composites based on natural fibers have very good implication in the automotive and transportation industry. The first car maker to use polymers filled with natural fiber was Mercedes-Benz in the 90s, by manufacturing door panels containing jute fibers, already explored industrial application include window and door frames, furniture, railroad sleepers, automotive panels and gardening items, packaging, shelves and in general those application which do not require very high mechanical resistance but, instead low purchasing and maintenance cost. Furthermore, it is possible and convenient to use recycled polymers in place of virgin ones, thus assuring improved cost efficiency and introduced as reinforcement in both thermoplastic and thermoset polymer based composites and have found extensive applications in transportation (automobile and railway coach interior, boat etc.), applications can be easily found on the technical literature and on the internet; these include, for instance, indoor furniture panels, footboards and platforms, automotive panels and noise insulating panels etc. mainly produced by American, German, Japanese, British and Italian firms. In particular, the role of automotive industry in this field is of primary importance. Bulletproof panels were made from ramie fiber reinforced composites by hand lay-up process with epoxy as a matrix . These prototype bulletproof panels were believed to be lighter in weight and more economical than conventional bulletproof panels.

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