



Study Of Mechanical Properties Of Fiber Reinforced Polymer Composite Material

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Abstract: The naturally available material such as Sisal has been using in several applications in fabricating composite materials due to its exceptional durability with a minimum wear and tear and due to its ability to stretch. Using sisal fiber as reinforcement to form sisal fiber reinforced polymer composites, strengthen the study of mechanical properties of the composites. In this project, we have enhanced the mechanical properties of the sisal/glass fiber incorporated with polyurethane. Polyurethane is an extremely versatile elastomer used in countless applications worldwide. It has some excellent properties like high abrasive resistance, wide range of hardness, high load bearing capacity, wide resilience range, flexibility, strong bonding properties which makes it an ideal choice in the field of composite preparation. In this study, the composite material is fabricated by mixing Polyurethane proportionally with the sisal/glass fiber. After the fabrication is done, it is planned to study the mechanical properties of the composite material using different testing tools like Universal Testing Machine, Izod test, and hardness tester.

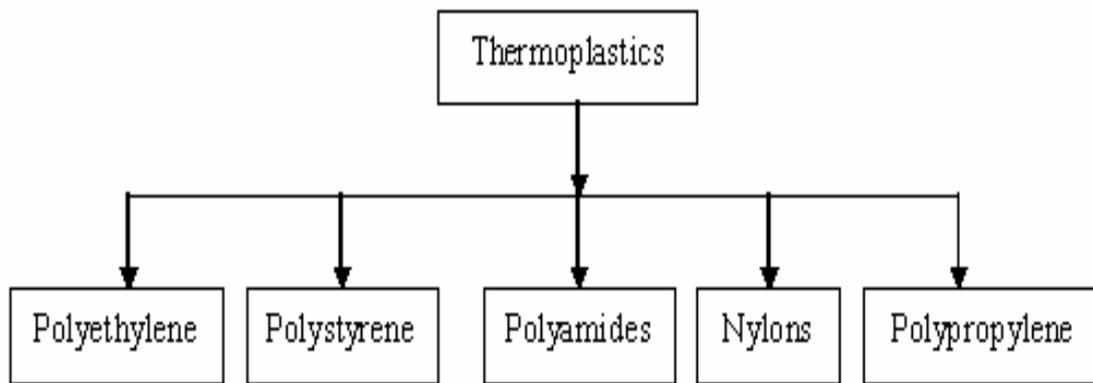
Index Terms - sisal fiber, polyurethane, polymer, composite.

I. INTRODUCTION

Polymer Matrix Composites are very popular due to their low cost and simple fabrication methods. Polymers make ideal materials as they can be processed easily, possess lightweight, and desirable mechanical properties. It follows, therefore, that high temperature resins are extensively used in aeronautical applications. Two kinds of polymers are thermosets and thermoplastics. Thermosets have qualities such as a well-bonded three-dimensional molecular structure after curing. They decompose instead of melting on hardening. Merely changing the basic composition of the resin is enough to alter the conditions suitably for curing and determine its other characteristics. They can be retained in a partially cured condition too over prolonged periods of time, rendering Thermosets very flexible. Thus, they are most suited as matrix bases for advanced conditions fiber reinforced composites. Thermosets find wide ranging applications in the chopped fiber composites form particularly when a premixed or molding compound with fibers of specific quality and aspect ratio happens to be starting material as in epoxy, polymer and phenolic polyamide resins.

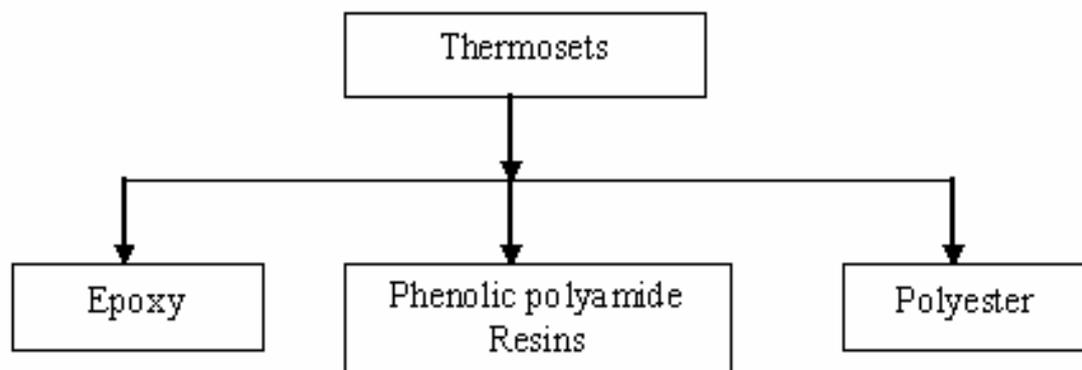
Thermoplastics have one- or two-dimensional molecular structure and they tend to at an elevated temperature and show exaggerated melting point. Another advantage is that the process of softening at elevated temperatures can reversed to regain its properties during cooling, facilitating applications of conventional compress techniques to mold the compounds. Resins reinforced with thermoplastics now

comprised an emerging group of composites. The theme of most experiments in this area to improve the base properties of the resins and extract the greatest functional advantages from them in new avenues, including attempts to replace metals in die-casting processes. In crystalline thermoplastics, the reinforcement affects the morphology to a considerable extent, prompting the reinforcement to empower nucleation. Whenever crystalline or amorphous, these resins possess the facility to alter their creep over an extensive range of temperature. But this range includes the point at which the usage of resins is constrained, and the reinforcement in such systems can increase the failure load as well as creep resistance.



Thermoplastics

Thermosets are the most popular of the fiber composite matrices without which, research and development in structural engineering field could get truncated. Aerospace components, automobile parts, defense systems etc., use a great deal of this type of fiber composites. Epoxy matrix materials are used in printed circuit boards and similar areas.



II. EXPERIMENTAL SETUP AND METHODOLOGY

2.1 Need for Various Processes

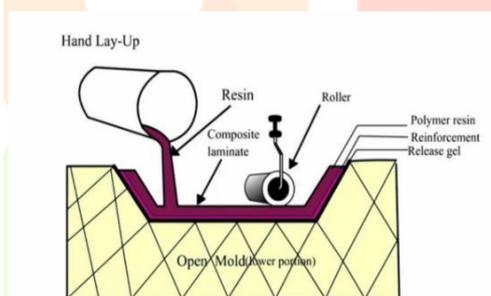
There are a wide variety of polymers and fibers available. Broadly the polymers can classify into two categories i.e. Thermosetting and Thermoplastic polymer. Similarly there are various reinforcements like carbon fibers, glass fiber, aramid fiber etc. (Synthetic fibers) also sisal fiber, banana fiber, jute fiber, silk fiber etc. (Natural fibers). Then there are shapes that we can produce only with a particular type of process, there are size limitations, quality restrictions, volume of production requirements per hour or per day. So, all these parameters ask for the implementation and development of wide variety of processes which can be

used for the processing of polymer composites. Each of these processes has its own application spectrum and can be used for the specific type of product only.

Introduction To Hand Layup Technique

It is the oldest, simplest, inexpensive and widely used method for processing of fiber reinforced polymer composites. This method is mostly suitable for continuous type of flat fiber reinforcements of any size (However size is restricted depending on the ease of use and curing time). This method does not require any tooling or equipment setups and as the name suggests, its basic principle underlies in manually laying up the fiber reinforcements over the alternate layers of polymer matrix and then finally bonding all the layers together under pressure using rollers.

In this process initially a release gel or wax is applied thoroughly over the open mold surface. Fiber reinforcements in the form of sheet or strands are placed over the surface of mold plate. The next layer is the polymer matrix which binds the reinforcements together. A known composition of polymer resin is prepared and is then slowly poured over the top of the fibers. Second layer of fiber is then stacked over alternately and then finally this sandwiched composite is rolled over by means of a roller which removes the trapped air and excess resin till it achieves the desired thickness. Now the composite is allowed to cure at room temperature or elevated temperature.



III. RESULTS AND DISCUSSION

3.1 TENSILE TEST RESULTS

Table 1 Tensile Test Results

Specimen No	Specimen composition	PU Powder (gm.)	Tensile strength (N/mm ²)
1	G+S+G+S+G	0	113.845
2	G+S+G+S+G	5	54.275
3	G+S+G+S+G	10	57.882
4	G+G+G+G	0	214.567
5	G+G+G+G	5	154.58
6	G+G+G+G	10	125.41

3.2 HARDNESS TEST RESULTS

Table 2 Rockwell Hardness.

Specimen no	Specimen composition	PU Powder (gm.)	HRC
1	G+S+G+S+G	0	58.625
2	G+S+G+S+G	7	79.125
3	G+S+G+S+G	10	39.75
4	2(G+G+G+G)	0	76.5
5	2(G+G+G+G)	8	64
6	2(G+G+G+G)	10	54.125
7	2(G+G+G+G)	12	34

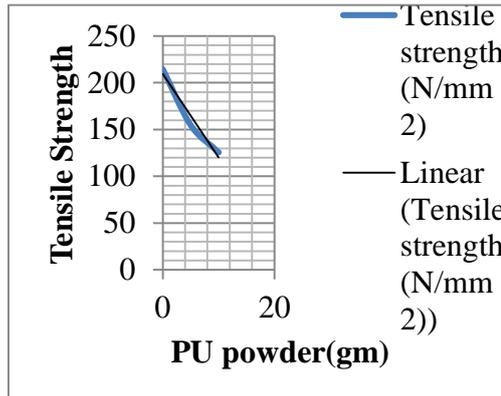
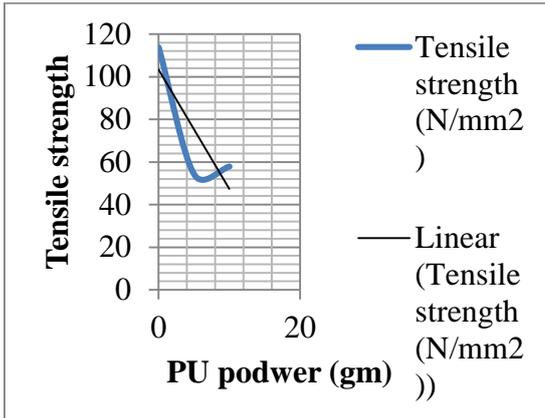
3.3 Impact Test Results.

Table 3 Impact Strength

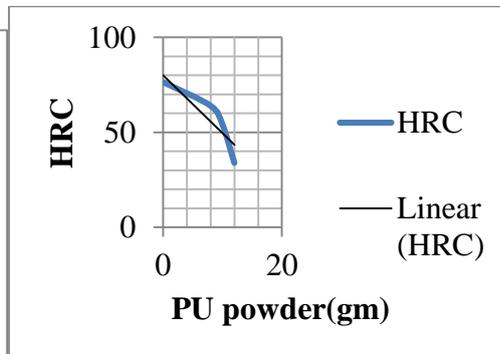
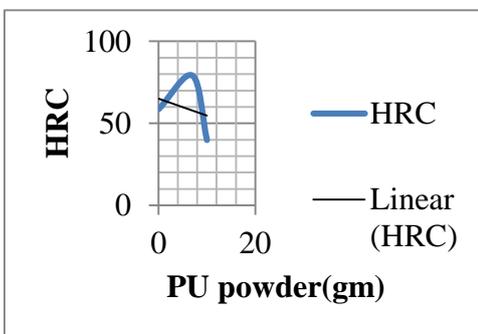
Specimen No	Specimen composition	PU Powder (gm.)	Impact strength (J/mm ²)
1	G+S+G+S+G	0	0.1
2	G+S+G+S+G	7	0.1
3	G+S+G+S+G	10	0.1
4	2(G+G+G+G)	0	0.05
5	2(G+G+G+G)	8	0.1
6	2(G+G+G+G)	10	0.05
7	2(G+G+G+G)	12	0.05

GRAPHS

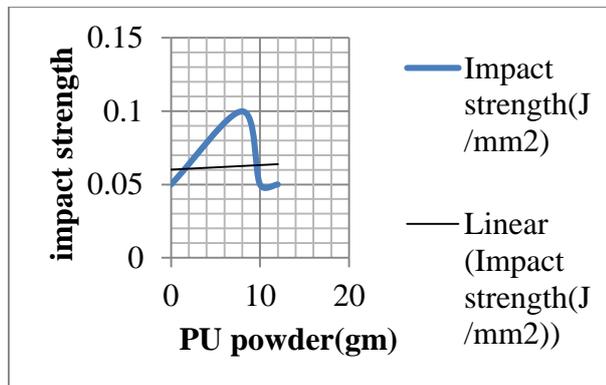
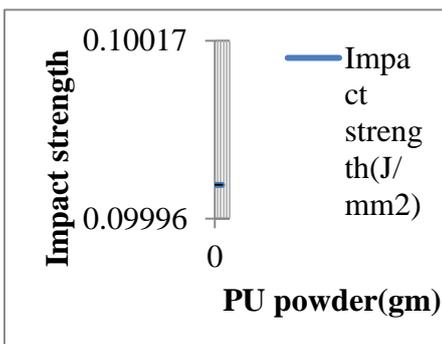
Tensile Test



Rockwell Hardness Test



Impact Test



IV. CONCLUSIONS

THE EXPERIMENTAL STUDY ON THE EFFECT OF THE FIBRE LOADING ON MECHANICAL BEHAVIOUR OF SISAL/GLASS FIBRE REINFORCED EPOXY BASED COMPOSITE RESULTS TO FOLLOWING CONCLUSIONS

1. It is observed that with the incorporation of PU (in ascending wt.%) into the glass/sisal fiber, the tensile strength of the specimen 3 has been increased when compared to specimen 2.
2. It is also observed that when there is no mixture of PU (i.e., 0% of PU) into glass/sisal fiber, the tensile strength of specimen 1 is increased rapidly compared to the specimen 2 and specimen 3.
3. It is concluded that when there is a combination of E-Glass fiber and Sisal fiber with PU, the tensile strength of the composite is increased with increase in the percentage of the PU, whereas when the PU was incorporated into only E-glass fiber, the tensile strength of E-Glass is decreased with increase in the percentage of the PU.
4. It is observed that when there is a combination of E-Glass fiber and Sisal fiber with PU, the hardness value of the composite is decreased with increase in percentage of PU and similarly the same variation in the value of hardness was observed for E-glass fiber.
5. It is then observed, the composite with E-glass /sisal fiber with PU, the impact strength remains unchanged with increase in the percentage of PU, whereas a small deflection was found when it was a combination of only E-Glass fiber with PU.

V. REFERENCES

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