ISSN 0974 - 9373

Vol. 15 (2011) Special Issue 2 **Journal of International Academy of Physical Sciences** pp. 529-535

# Fabrication and Testing of Biodegradable Composite*

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(Received June 14, 2011)

**Abstract:** The conventional materials like iron, mild steel, cast iron etc is having good mechanical properties. Hence they will be used in structural engineering applications. These conventional materials are having some defects like formation of rust, low weight to strength ratio, high production cost. To overcome this defect the engineers are fabricating the composite materials. The composites will exhibit peculiar properties like different strengths in different direction, rust resistant, high strength to weight ratio. But these composites will be polluting the environment. Now the natural fiber composites are wildly used in automobile industry. The natural fibers and resins are used to fabricate an eco friendly composite material. Lack of resources and increasing environment pollution has evoked great interest in the research of materials that are friendly to our health and environment. Biopolymer composites fabricated from natural fibers is currently the most promising areas in polymer sciences. This is designed to assess the possibility of fiber as reinforcing material in composites. Urea formaldehyde resin was synthesized used as matrix and made a stiffened panel to conduct a tensile test. In this paper it is aimed to explain the all possible ways to use natural composites in an automobile. The main advantage of using natural fibers is its degradability and light weight. They are environmentally friendly and also increase the fuel economy the urea formaldehyde resin reinforced with bandage cotton fiber of different dimensions used for making of laminates.

**Keywords:** Natural fibers, Natural composites, automobile parts, biodegradable.

## 1. Introduction

Composites have been around for a long time with the classic example of bricks made from straw and mud. Another example is the Mongolian bow which was constructed out of animal tendons, wood, and silk bonded together with an adhesive. Nature also has its own composites in the form of

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*Paper presented in CONIAPS XIII at UPES, Dehradun during June 14-16, 2011.

wood, teeth, bones, muscle tissue, etc. In general the composite materials consist of a matrix reinforced with particles or fibers. Natural fibers were used for reinforcing the matrix until early in to the mid 20th century. However since 1950 there was an increased demand for stronger and stiffer, and light weight composites, in the fields such as aerospace, transportation and construction. These newer composites have low specific gravity, superior strength and modulus when compared to the traditionally engineering materials like metals. Due to their strength to weight ratio and comparable or better mechanical properties, composites are gaining grounds in industrial applications where traditionally metals were used. Table 1 lists some of the benefits of using a composite in lieu of metals.

## 2. Materials and Methodology

The experimental setup for the UF resin production is shown in Fig. In the first stage of the process, formaldehyde was poured into the flask followed by urea. The mixture was blended homogeneously by using a stirrer. The mixture was a white-colored solution. The solution pH and temperature were recorded simultaneously. In order to prevent the solution from polymerizing too quickly, the pH was adjusted to between 8.8 - 9.0 by adding a few drops of sodium hydroxide.

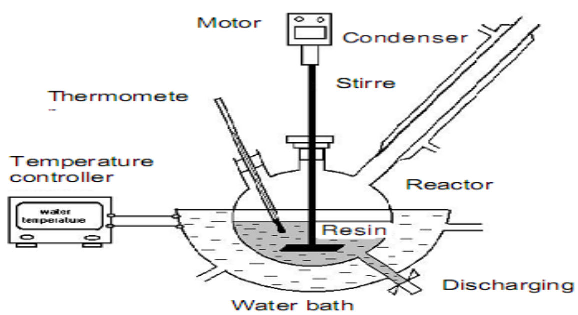



Figure 3: Schematic diagram

Within 50–60 minutes, the temperature was gradually increased until it reached 80° C. During this period, the pH dropped naturally to below 7.5. At a temperature range of between 58° C– 60° C, the mixture turned clear. As the temperature reached 80° C and the pH dropped to below 7.5, polymerization process proceeded to a second stage where optimum polymerization for UF resin occurred. Refluxing was continued until the end point (E.P) is reached. The E.P could be determined by dropping the solution mixture into a beaker of water at 50° C for every 5 – 10 minutes. If there is no whitish steak when the droplet is diluted in water, this means that the end point has not been reached. For a lower degree of polymerization (DP), the end point can be detected by using a lower water temperature.

In stage 3 of the process, the pH was adjusted to between 8.8 – 9.5 when the end point was reached. The resin was then allowed to cool down to the ambient temperature. Additional urea was poured into the mixture when the temperature dropped to 65°C. Finally, the pH was adjusted to a range between 9.5 – 9.8. The resin was transferred on to woven bandage cloth.

## 3. Hand lay-up

Resin made up of with urea and formaldehyde deposited onto the fiber impregnated reinforcement by a brush. This requires little capital equipment but is labor intensive. It is particularly suited for a limited number of a particular structure. The main disadvantages of this method are the low reinforcement content and the difficulty in removing all the trapped air, hence the mechanical properties are not as good as in other processes

By using the hand lay-up process we prepared a laminate, resin which is formed poured on to the three layers folded bandage cloth. It takes three to four weeks to dry the laminate for to get strengthen

Figure UF sampleTensile testing

After getting strength we prepare the specimens with sharp chisel. The following figure shows samples to conduct tensile test. Tensile test was conducted Computerized Universal Testing Machines - Electro Hydraulic UTM TUE 600C RAGHAVENDRA SPECTRO METALLURGICAL LABORATORY, Hyderabad on tensile testing machine to find the properties of a specimen.

Before test

After test conducted from the test we obtained stress Vs stain relationship graph and cross head Vs load

## 4. Results

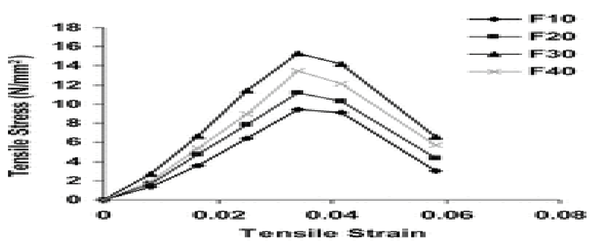
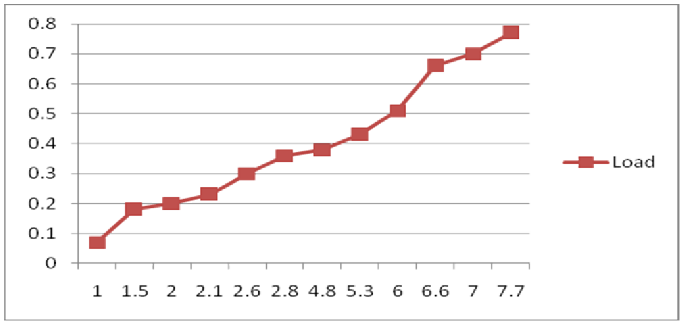



Figure: Stress strain curve obtained by at NIT Hamirpur

Results obtained by conducting tensile test at Raghavendra Spectro metallurgical laboratory Hyderabad

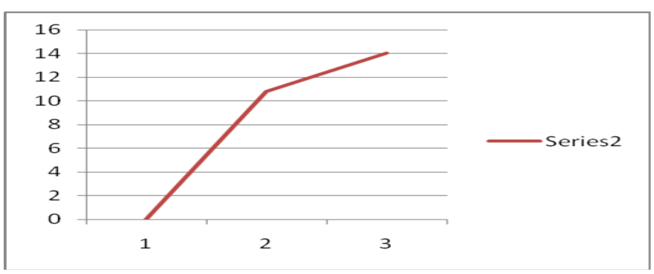
| cross head in Cm | Load in N | Original L | Change L | Strain |
|---|---|---|---|---|
| 1 | 0.07 | 50 | 51 | 1.02 |
| 1.5 | 0.18 | 50 | 51.5 | 1.03 |
| 2 | 0.2 | 50 | 52 | 1.04 |
| 2.1 | 0.23 | 50 | 52.1 | 1.042 |

| | | | | |
|---|---|---|---|---|
| 2.6 | 0.3 | 50 | 52.6 | 1.052 |
| 2.8 | 0.36 | 50 | 52.8 | 1.056 |
| 4.8 | 0.38 | 50 | 54.8 | 1.096 |
| 5.3 | 0.43 | 50 | 55.3 | 1.106 |
| 6 | 0.51 | 50 | 56 | 1.12 |
| 6.6 | 0.66 | 50 | 56.6 | 1.132 |
| 7 | 0.7 | 50 | 57 | 1.14 |
| 7.7 | 0.77 | 50 | 57.7 | 1.154 |




Cross head displacements
Figure: Load v/s Cross head displacement

| | strain | stress |
|---|---|---|
| Starting | 0 | 0 |
| Yielding point | 1.12 | 10.793 |
| Peak point | 1.154 | 14.03 |




Stress V/Strain.

The stress at Yield point is 1.12

1. The stress at Yield point is 10.793 N/mm $^{2}$ , at Peak is 14.03 N/mm $^{2}$ and the Strain at Yield point is 1.12 , at Peak is 1.15
2. The results obtained are similar to the results obtained by Vijay Kumar Thakur and A. S. Sinha of Nit Hamirpur in their paper Renewable resource-based green polymer composites: analysis and characterization
   They got stress value about 14 N/mm $^{2}$ for 40 % formal dehyde resin and 60% pine fiber composite
3. The load v/s cross head and Stress V/s Strain graph shows that the composite material behaves like a brittle material.
4. The curve in load v/s cross head should a straight line; the reason may be the improper curing. The curing should be done by adding ammonium chloride.

## 5. Applications

figure :Interior parts of the Mercedes A-200 reinforced by natural fibers

## 6. Conclusion

Within the composite industry, NF composites form an interesting group. Bio-composites often lead to a reduction in weight and costs and are more environmental friendly. For these reasons the popularity of these composites is increasing in the day by day in the world and already a significant amount of scientific knowledge is generated. In this paper we presented the comparison of the properties of laminate who prepared in NIT.

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