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Preparation and Testing of a Composite Plate Using Shrimp Shell Filler

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ABSTRACT:

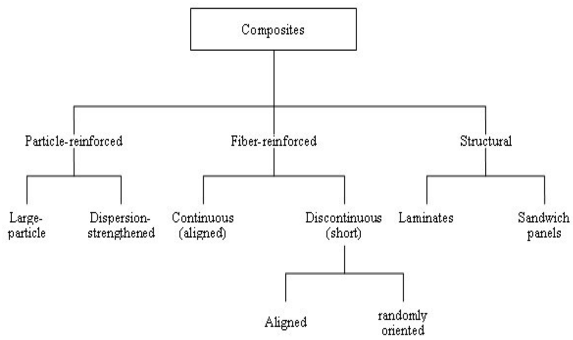
Composite materials[6] have interesting properties such as high strength to weight ratio, ease of fabrication, good electrical and thermal properties compared to metals. A composite material consists of several layers of a composite mixture consisting of matrix and fibers. Each layer may have similar or dissimilar material properties with different fiber orientations under varying stacking sequence .The major composite which is used in this project are SHRIMP SHELLS filler .This shrimp shells are converted as filler by the chemical process and added as an ingredient to the composite material in order to increase the strength of the composite material and to obtain the more accurate results. In this the composites are prepared and tensile testing is done on it

1. INTRODUCTION :

Today Composites [1] are receiving much attention not only because they are on the cutting edge of active material research field but also because there is a great deal of promise for their potential applications in various industries ranging from aerospace to construction due to their various outstanding properties. Realities of the modern world demand that engineering materials simultaneously possess high stiffness, strength and impact toughness, which is not a trivial task. Typically, stiff and strong materials such as ceramics are brittle, whereas tough materials, for example rubber, are soft and weak. On an Ashby plot this translates into an inverse correlation between strength and toughness. Such problematic behavior, however, is much less pronounced in natural composites like nacre, bone, turtle shell or sponge spicule, where a number of complex reinforcing mechanisms including crack bridging, crack deflection and geometric/structural intricacy provide resistance to fracture propagation and impact toughness.

2. LITERATURE REVIEW:

A composite material (also called a composition material or shortened to composite) is a material[2] made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components .The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials.Composite materials are generally used for buildings, bridges, and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, bath tubs, storage tanks, imitation imitation granite and cultured marble sinks and countertop. Woody plants, both true wood from trees and plants such as palms and bamboo, yield natural composites that were used prehistorically by mankind and are still used widely in construction and scaffolding.One of the most common and familiar composite is fiber-glass, in which small glass fiber are embedded within a polymeric material (normally an epoxy or polyester). The glass fiber is relatively strong and stiff (but also brittle), whereas the polymer is ductile (but also weak and flexi-ble). Thus the resulting fiberglass is relatively stiff, strong, flexible, and has ductile strength especially at higher tem-peratures. It has improved thermal shock resistance and corrosion resistance. Increase in Young's modulus and re-duction of thermal elongation.



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Composites are made up of individual materials referred to as constituent materials. There are two main categories of constituent materials: matrix and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. A synergism produces material properties unavailable from the individual constituent materials, while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination. Engineered composite materials must be formed to shape. The matrix material can be introduced to the reinforcement before or after the reinforcement material is placed into the mould cavity or onto the mould surface. The matrix material experiences a melting event, after which the part shape is essentially set. Depending upon the nature of the matrix material, this melting event can occur in various ways such as chemical polymerization or solidification .One of the most common and familiar composite is fiberglass, in which small glass fiber are embedded within a polymeric material (normally an epoxy or polyester). The glass fiber is relatively strong and stiff (but also brittle).

3. PURPOSE OF RESEARCH :

The main purpose of this research is to find the strength of the composite material with filler ingredient and with out filler ingredients.As we all know that composite materials are strong enough with their properties and nature, but by adding other ingredients to this composites we can increase more strength and accuracy .So, in order to increase the stiffness to that material composite , in my research I am using the filler to the composite material. The filler which I am using to this composite is the shrimp shells filler, this filler is conversted to powder and this mixture is add to the composite while preparation of the composite . By adding this filler to composite the quantity of the composite can be reduced because the filler is being added. Due to this the strength of the material will increase and the thickness can be reduced and material quantity can be reduced easily. So, in this the composites and filler are mixed and different testing has been done. By this research I can prove that strength and efficiency can be better when compared to the composite material without any ingredients.The reinforcement of metals can have many different ob-jectives.

Tensile tests are performed on two different material and the load Vs displacement graph is obtained in each case .The ultimate load, elongation and area of cross section according to standards is considered to calculate the ultimate tensile strength and young's modulus of the specimens .

4. PREPARATION METHOD :

4.1 GLASS FIBER:

It is a material made of extremely fine fibers of Glass [5] material . It is used as a reinforcement in the polymer. It is a light weight material used to form the reinforced polymer. The fiber pieces are taken according to dimension of 300mmX10mmX7mm.

4.2 FABRICATION OF COMPOSITE MATERIAL:

The preparation of COMPOSITE MATERIAL involves the following major activities. A brief illustration of the activities is given below.

Fig 1: COMPOSITE MATERIAL

The above figure shows the preparation of Composite by the combination of GLASS fiber, Shrimp shell powder 100 gms and resin by manual layup method.

4.3 Material Deposition:

In this releasing agent is applied on the mould and it is set to dry for 2 minutes. Then the resin mixture is applied on the surface of the mould and the GLASS fiber piece is placed on it. Again resin is applied and fiber is placed till we get 4 layers. Now the metal sheet is placed and again 4 layers of resin and fiber are placed on the metal sheet in the form of a laminate. The major composite which is used in this project are SHRIMP SHELLS filler upon arrival at the Laboratory,

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the visible fat was mechanically removed, while the shrimp shell was washed with warm water and slight ethanol before stored in the freezer until it was used for the experiments. Prior to be used, the shrimp shell was allowed to reach room temperature, and dried under the heat of the sun, crushed and sieved

4.4 Material Deposition:

Hydrochloric acid (HCl), sulfuric acid (H_2SO_4), nitric acid (HNO_3), oxalic acid ($H_2C_2O_4$), Na borax and NaOH .The shrimp shell powder was soaked in a HCl solution for 24 hours at room temperature with ratio of shrimp shell powder [7]and HCl solution was 1:6 (m/v).

4.6 Cyclic process for converting shrimp shells to paste:

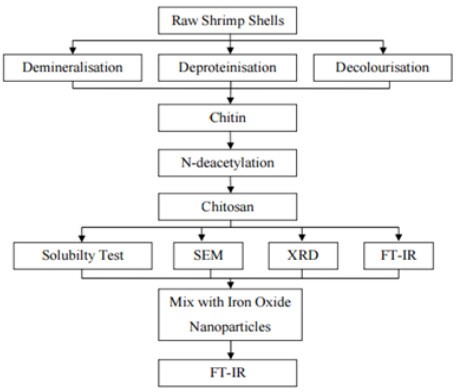


Fig 2. Composite as per dimensions according to ASTM standards

5. RESULTS AND DISUCSSIONS:

Tensile tests are performed on two different material and the load Vs displacement graph is obtained in each case .The ultimate load, elongation and area of cross section according to standards is considered to calculate the ultimate tensile strength and young's modulus of the specimens .By the two graphs we can see the differences in the strength of the materials .By this the strength of the composite material with filler is more than without filler.

From the tensile test the ultimate load for particular elongation is found. The ultimate tensile strength and Young's modulus are calculated as follows:

•Ultimate tensile strength = Ultimate load/Area of cross section.
•Young's Modulus E = Ultimate tensile strength / Strain.
•Strain = change in length / Original length.

4.5 TESTING:

The composite is machined as per dimensions shown in the below figure and the area of cross section 12.785mm X 6.96. 6mm is maintained for all specimens. In order to perform tensile test on a laminate it is made to required dimensions as per ASTM[3] standards

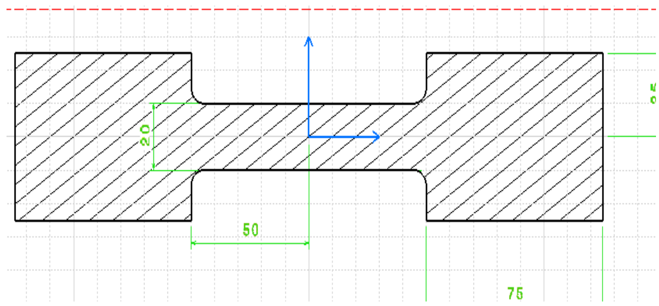
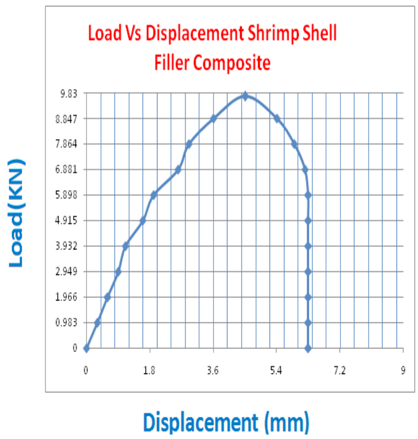


Fig 3. Metal piece placed in Universal Testing Machine



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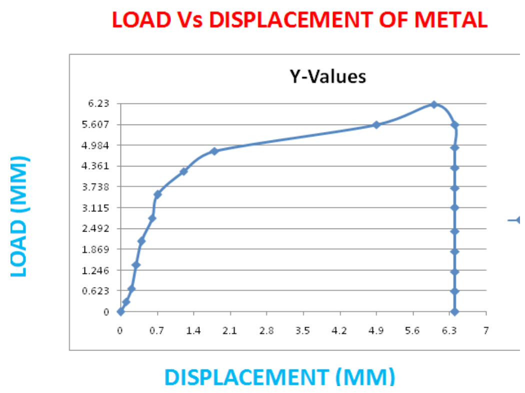

Standard Fiber Properties

	US Units	SI Units
Tensile Strength	600 Ksi	4137 MPa
Tensile Modulus	35 Msi	242 GPa
Elongation	1.5%	
Density	0.065 lb/in^3	1.81 g/cc
Fiber Diameter	0.283 mils	7.2 microns
Carbon Content	95%	
Yield	400 ft/lb	270 m/kg

Fig: Properties[4]

Glass Fiber Mechanical Properties

	E-glass	R-glass	HS2,HS4	T-glass	S-1	S-2
Tensile Strength GPa	1.9-2.5	3.1-3.4	3.1-4.0	4.0-4.2	3.8-4.1	4.3-4.6
Tensile Modulus GPa	69-80	86-89	82-90	84	85-87	88-91

6.CONCLUSION:

Both materials have equal properties but overall the superior material fiber glass. So by adding the shrimp shell powder as an ingredient to fiber glass the strength of fiberglass would be considered the stronger material due to its nature to flex to avoid breaking. Also the price of fiberglass makes it superior to carbon fiber in certain aspects. In much of the commercial consumer market carbon fiber has been favored; this has resulted to extreme raises in the prices in products that involve carbon fiber. Fiber glass has proven itself to be superior in the industrial industry.

.MATERIAL	FIBER GLASS WITH SHRIMP SHELL POWDER	CARBON FIBER WITH OUT SHRIMP SHELL
ULTIMATE TENSILE STRENGTH	73.23	62.23

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