Experimental Analysis of Mechanical Properties in E-Glass Fiber Pipe

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Abstract

Now a day's composite material products are gently used in fiber industry and automobile applications. Because of it light weight, Low cost and high strength. There are various varieties of synthetic fibers are the properties were identified. But glass fiber is give high strength in low cost. The fibers it will be mixing resin to get good mechanical properties. In this work use E-glass fiber, Resin and hardener to make a composite fiber pipe. We fabricated a standard test specimen in each E-glass fiber (E-glass fiber, Resin + hardener). There addition of additives has to be done to fabricate composite fiber pipe. Finally Hardener is added improve it hardness separately and tested in Micro Hardness Test, Universal Testing Machine, from analysis we found that composite E-glass fiber, Resin + hardener got better Hardness.

Keywords: E-Glass Fiber Pipe, Epoxy resin (ly566), Universal compressive testing machines (UTM)

I. INTRODUCTION

A composite material is made by combining two or more materials often ones that have very different properties. The two materials work together to give the composite unique Properties. However, within the composite you can easily tell the different materials apart as they do not dissolve or blend into each other. For the specific carbon and glass fiber based composite Materials often referred to loosely as composites, Fiber-reinforced polymer. Composites are formed by combining materials together to form an overall structure that is better than the Individual components.

II. LITERATURE SURVEY

Agarwal.B.D, Bhagwan D.[1] et All It provides a complete, up-to-date treatment of the mechanics, characterization materials, analysis, fabrication and performance of composite materials, The book features new material on such cutting-edge topics as analyze structures, smart composite structures, and computer software for composite structure analysis. Analysis of laminated plates and beams rising composite materials Measurement of physical properties Analysis of orthotropic lamina Thermal stresses Free-edge effects joints Fracture mechanics Complete with control for using the latest MATLAB software for analysis. Charles et all [3] had be Aluminum, Copper Steel, Glass Polyethylene, Polystyrene, Polymethyl methacrylate, Nylon properties analyzed, and Linear, branched, and cross-linked polymer structures analyzed and also discussed with natural and synthetic fibers. It will be E-glass fiber is similar properties than other fibers. Srinivasulu and Tejaswi [10] had discussed the properties of composite materials in this paper. Further the importance and replacement of the metals with low weight and corrosion resistant composite had been discussed. Peter F. Infante [4] have combination of study results from experimental animals and humans and the data on fiber characteristics is realistic enough that in charge parties should treat reparable glass fibers (and slag wool and rock wool) as if they are carcinogenic and take action where appropriate to reduce such worker exposures. Also the lung cancer risk to workers employed in the spraying of insulation wool in confined spaces could potentially be elevated if protective equipment is not used. Chase that fiberglass is not carcinogenic would seem to indicate that they have learned nothing from the sad history of asbestos. In this work carried out the composite pipe are making in using of fiber reinforcement is glass fiber and matrix material is epoxy resin The combinations of resin and fibers give better mechanical and physical properties. With the help of that properties fabrication of composite fiber pipe is to be fabricated. Then the behavior of the composite fiber pipe is to be tested different condition.

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A. The Objectives of This Work Are Outlined As Follows:

1) Fabrication of a new class of low cost composites using micro-sized E-glass fiber as the Reinforcing filler with an objective to compare fiber pipe to various pipes.
2) To find mechanical properties using various testing method.
3) Validation of the various testing method by measuring the thermal expansion values experimentally.
4) Recommendation of these composites for suitable applications.

B. Raw Materials and Formulations:

1) E-Glass Fiber
2) Epoxy Resin (Ly566)
3) Hardener
4) Wax

1) E-glass fiber

a) Why E-glass fiber?

The 'E' in E glass stands for 'electrical' and was intended to indicate that the material had low electrical conductivity. This is rarely the criterion upon which it is chosen, its popularity is mainly due to the fact that it is the cheapest glass fiber and is therefore the preferred material in general purpose products. The glass fibers, it classified into E-glass, A-glass, R-glass etc. The potential of fibers of graphite, silica carbide and boron are also exercising the scientific mind due to their applications in advanced composites. The most important reason is the selecting this fiber is Chemical resistant, low cost and similar strength in other glass fibers.

b) Properties:

1) Specific Strength
2) Low density
3) Corrosion resistance
4) Impact resistance
5) Electrical resistance

c) Epoxy resin (ly566)

Epoxy resins are polyether resins containing more than one epoxy group capable of being converted into the thermo set form. Two important mechanical properties of any resin systems are its tensile strength and stiffness. These resins on curing are very high strength. Epoxy resins can exhibit outstanding resistance to heat up to 290°C and electrical insulation properties. They can be either liquid or solid form and can be formulated to cure either at room temperature of with the aid of heat.

Epoxy resins have performance advantages over polyester and vinyl esters in five major areas:

1) Better adhesive properties (the ability to bond to the reinforcement or core)
2) Superior mechanical properties (particularly strength and stiffness)
3) Improved resistance to fatigue and micro cracking
4) Reduced degradation from water ingress (diminution of properties due to water penetration)
5) Increased resistance to osmosis (surface degradation due to water permeability)

2) Hardener

Hardener is mixing with resin is the ratio is 10:1 it give more strength and degrees the resin curing time

C. Fabrication Method:

Fabrication process started with cleaning the glass tube Length * Inner diameter *outer diameter (300*26*28mm) which used as the base of the laminate layers of composite materials. Apply anti-adhesive and E-glass fiber was put on the glass tube and resin was poured on the fiber.

The amount of mixing in resin and Hardener ratio is 10:1, E-glass fiber and resin weight ratio is 65% & 35% will be tacking because they are equal percentage of fiber and resin is doesn't give good mechanical properties.

The fiber is winding in hoop and helical winding. Hoop winding is rotating the fiber angle is 0◦.and next layer is helical winding angle is 45◦.the two combination winding is to give more mechanical strength. They are winding in four layers (0◦/45◦/0◦/45◦) this forming in symmetric laminate it gives more compressive and tensile strength.

This process was carry-on until the resin was enclosed and adhere the whole E-glass fiber. This is to make sure the resins are totally absorbed by the fibers and provide a good adhesive bonding between fibers and resins. After first layer of the composite laminate is totally wet and adhere by resins, the steps are repeated for second layer of the laminate until the third and fourth layer. It is left for 24 hours for curing purpose.

Finlay the fiber pipe dimensions are 300*28*36mm (Length*Inner dia*outer dia).Thickness of the pipe is 4 mm. Then the behavior of the composite fiber pipe is to be tested different load conditions.

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Fig. 1:

D. Testing:

- Compression Test
- Hardness Test

E. Compression Test:

Universal compressive testing machines (UTM), Venire calipers, stop watch, dial gauge. Are used the Structure components such as columns and struts are subjected to compressive load in applications. These components are made of high compressive strength materials. Not all the materials are strong in compression. Several materials, which are good in tension, are poor in compression. Many materials poor in tension are good in compression. Cast iron is one such example. This strength is determined by conducting a compression test. During the test, for ASTM standard the specimen is compressed and deformation Vs. stress the applied is recorded. Compression test is just opposite in nature to tensile test. Nature of deformation and fracture is quite different from that in tensile test. Compressive load tends to squeeze the specimen. Brittle materials are generally weak in tension but strong in compression

Fig. 2: During the compression test

F. After Compression Test:

Fig. 3: Compressed Specimen

G. Hardness Testing:

Hardness is the property of a material that enables it to resist plastic deformation, usually by penetration. However, the term hardness may also refer to resistance to bending, scratching, abrasion or cutting. Hardness value of PVC and E-glass fiber pipe are compared. The values of E-glass fiber are showing better than PVC hardness. This indicates that the E-glass fiber can used in similar conditions of PVC usage.

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Fig. 4: Testing Of Specimen in Instron Machine

MATERIAL	*HARDNES TEST RESULT (Hv)*	*COMPRESSION TEST RESULT (N/mm^2)*
E-GLASS (Composite Material)	*22.9*	*77.5*
Poly-vinyl-chloride (PVC)	*11.5*	*65.5*

III. RESULT AND DISCUSSIONS

A. The Test Results And Graph For The Test Specimen Are Discussed As Follows.

The graph (figure. 1. Stress Vs displacement) indicates that the displacement increases with increase in stress values up to certain limit. The displacement value at the maximum load is 5.990mm.ultimate stress value of the specimen is about 0.077KN/mm^2

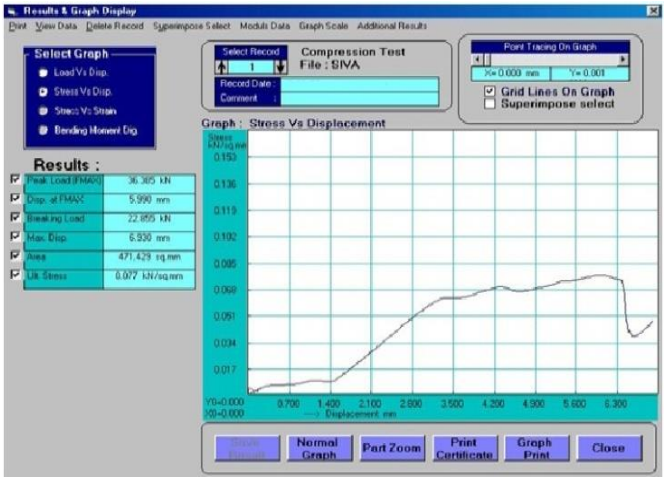

Fig. 1: Stress Vs displacement

The graph is (figure. 2. Load Vs displacement) indicate that the displacement increases with increase in the load value up to the certain limit. The peak load value is 36.396KN further than which the material fails.

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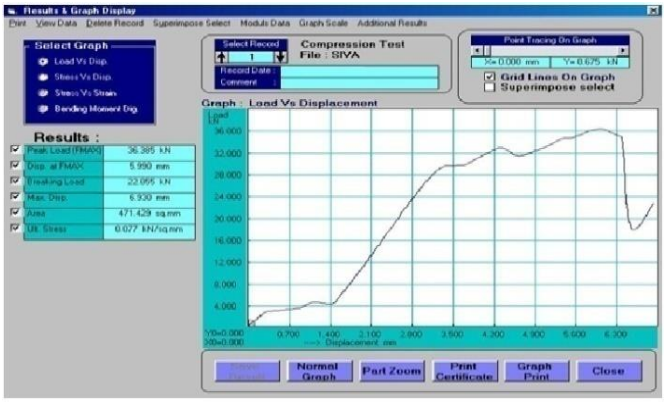

Fig. 2: Load Vs displacement

IV. APPLICATION

1) The composite fiber pipe are using in home and comesrisal application such as window screen pipe, bus handles.
2) E-glass fiber is high electrical resistance so it will be used in electrical pipe line applications.
3) They are using composite fiber pipe Automobiles for low weight acting application and also it is a light weight material.
4) There is no chemical reaction in any other materials so it will be used for Chemical industry application.
5) The composite fiber pipe are using epoxy resin is matrix so it will not form in slag, corrosion, inner pipe deposition of salt are minimizing.

V. CONCLUSION

The work carried out by us made an impressing task in the field of composite material. Here we are using E Glass Fiber Pipe. They are E-glass fiber pipe hardness is 22.9 Hv and Poly- vinyl-chloride is 11.5 Hv and also the find in graph (Fig.1.) The displacement value at the maximum load is 5.990mm.ultimate stress value of the specimen is about 0.077KN/mm2 and Fig.2.intigate peak load value is 36.396KN further than which the material fails. so we are concluded that E Glass Fiber Material having better hardness then PVC material and also fabrication cost also less when compared with PVC pipe fabrication.

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