ANALYSIS OF DEFECTS AND MECHANICAL PROPERTIES OF E-GLASS/CHOPPED STAND MAT REINFORCED POLYMER COMPOSITE

[1]Ganti Venkateswara Rao,[2]Javvadi Eswara Manikanta,[3]Dunna NarendraBabu

Assistant professor
Mechanical Engineering Department,
B.V.C. Engineering College, Odalarevu, Andhrapradesh,India

Abstract : The fiber reinforced polymer composites are more widely used in the aerospace industries, automotive industries and other industrial applications, due to their applicable benefits like light weight, ease of processing, high stiffness, high strength etc.In the present project, the work aims to analysis of defects and mechanical properties of E-glass and Chopped strand mat E 450 GSM reinforced polymer composites. Composites are fabricated with combination of E-glass (woven roving) with Chopped strand mat E 450GSM and silicon powder in weight ratios respectively with respect to increase in the layers of E-glass fiber with epoxy as a matrix material using hand lay-up method because of its applicable benefits like ease of manufacturing, less consumption of time and economy of manufacturing. For finding the Defects and Mechanical properties conducted Non Destructive and Destructive Testing's. The composite samples were made in the form of a plate. The fabricated composite materials in the form of plate were cut into profiles as per ASTM standards for Testing's. The Tensile strength results of polymer composite materials improved with addition of E-glass in Epoxy matrix.The Impact test results of polymer composites improved with addition of 15gms SiC, E-glass and Chopped Strand Mat.The Hardness test results of polymer composites improved with addition of 10gms SiC, E-glass and chopped strand mat. In Ultrasonic test Chopped Strand Mat based Epoxy polymer composite have low Defects compared with other composites.

***IndexTerms*–Epoxy composite,Hand layup technique, Ultrasonic testing, Destructivetestings.**

I. INTRODUCTION

Fiber reinforced plastics have been widely used for manufacturing aircraft and spacecraft structural parts because of their particular mechanical and physical properties such as high specific strength and high specific stiffness. Another relevant application for fiber reinforced polymeric composites (especially glass fiber reinforced plastics) is in the electronic industry, in which they are employed for producing printed wiring boards. Concrete, steel, and wood are the most important components in the development of infrastructure. However,costs of construction have been increasing very significantly in recent years above the expectations [1]. In this context, synthetic, petroleum-based fiber reinforced polymer (FRP) composites have been found as best alternatives to conventional construction materials as they exhibit Higher strength and stiffness with reference to specific gravity; higher fatigue strength and impact energy absorption capacity; better resistance to corrosion, fire, acids, and natural hazardous environments; longer service life and lower life-cycle costs; better insulation and less toxicity as primary components for construction [1]. While composites have already proven their worth as well as weight-saving material, the current challenge is to make them cost-effective. To develop new class of polymer structural materials, the matrix modification of polymer is one of the best approaches. The properties of polymers are modified by reinforcing the glass fibers and carbon fibers in the form of carbon nano tubes (CNT) [2]. Glass fiber reinforced epoxy composites give the attractive combination of physical and mechanical properties which cannot be obtained by monolithic materials [3, 4].Mechanical properties of fiber Reinforced composites depends on type of fiber, quantity, fiber distribution andorientation and void content. Besides this, the nature of the interfacial bonds and the mechanism of load Transfer ofthe interphase also play an important role [5]. It is observed from literature that there is a significant improvement on mechanical properties of polyester based composites with the addition of micro fillers, which acts as additional Reinforcing components and enhances their mechanical properties and also reduces the processing cost significantly. The properties of these composites depend upon the type, size and weight percentage of the filler material used [6, 7].

II.1.PREPARATION OF SAMPLES

Epoxy resin (density 1.35gm/cc) is the matrix material in the present investigation. It is also known as athermosetting plastic and it can attach things together to itself, creating a strong bond. In the present work, E glass, chopped strand mat E-450 GSM and SiCfibers have been used as the reinforcing material. Glass is the most common fiber used in polymer matrix composites due to its high strength, low cost, high chemical resistance and good insulating properties. A catalyst (Methyl Ethyl Ketone Peroxide) and a hardner (Cobalt Oxolate) are used for fast curing of composites. The composites used for the present investigation are fabricated by hand lay-up method.Before the Epoxy resin for chopped strand mat and E glass is laid upon the mould, the mould should be dried and cleaned. Using a clean brush, the epoxy is laid up uniformly for the first layer onto the mould. The epoxy is blended with the SiC. The commixed epoxy and with the fiber is poured into the mould. The mould is closed and the composite material was pressed uniformly for 24h for remedying.

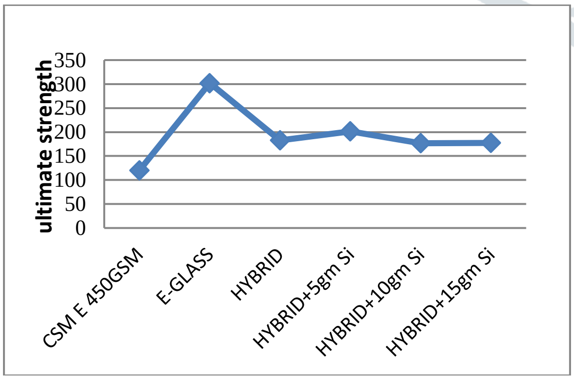
The composite laminates used for this analysis are prepared by hand lay-up techniques it is easy and commercially more economical than other techniques. Initially, woven roving E-glass fibre, chopped strand mat E 450 GSM each mat with 0.85 and 1mm thickness are taken. Cut the mats by 250mm×200mm dimension and take the weights of the mats and take the epoxy resin and mix the hardener in the ratio of 10:1. For the hybrid pieces added the silicon carbide in the weight ratios 5, 10, 15 grams. Then place a clear films with 75microns on the work table and apply epoxy resin mix on the sheet for mat dimension to stick the mat on the sheet firmly. Place a woven roving E-glass mat on the sheet and brush the epoxy throughout the mat. The same procedure is carried out for other layers of fibre till required thickness is obtained. Finally place another clear film on the top of the prepared composite to gain smooth surface. Then the composite laminates to prepared are dried at room temperature for 18 hours. The most curing is carried out in sunlight for 3 hours on each side of the laminate.

Fig:1 Composite preparation figures

III. RESULTS AND DISCUSSION

I. TensileTest:The machine comprises of a loading unit (or straining unit), control panel, Hydraulic system, pendulum dynamometer, load indicating system and load-elongation recording system. Tensile test is conducted by gripping the tests specimen between the upper and middle crosshead. Compression and Bending tests are conducted between the middle crosshead and the lower table.

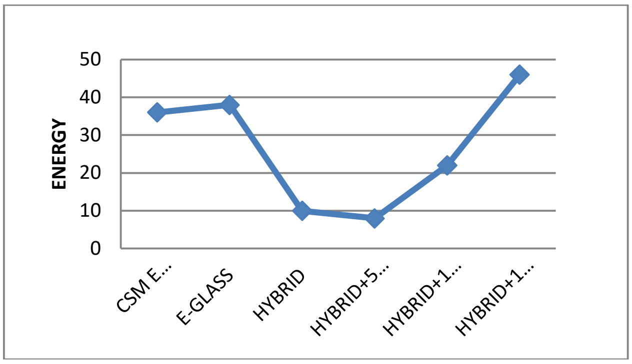
1. Ultimate tensile strength values of composites



S.No	Composite	Tensile strength(MPa)
1	CSM E 450 GSM	120.15
2	E-Glass	320.33
3	Hybrid	182.45
4	Hybrid with 5gm SiC	201.56
5	Hybrid with 10gm SiC	176.58
6	Hybrid with 15gm SiC	177.24

II. ImpactTest**:** The charpy impact V notch test was carried on impact tester. Prepare a test specimen as per ASTM D6110. The energy absorbed as determined by the subsequent rise of pendulum, is a measure of impact strength or material toughness and expressed in terms of Joules. The impact values that are obtained from the experiment are shown in the following tabular column.

2. Toughness values of composites

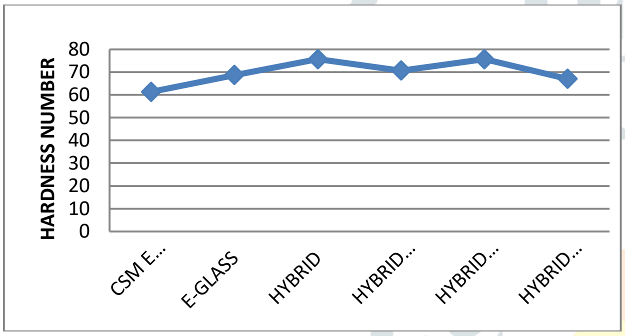


S.No	Composite	Impact strength(Joules)
1	CSM E 450 GSM	36
2	E-Glass	38
3	Hybrid	10
4	Hybrid with 5gm SiC	8
5	Hybrid with 10gm SiC	22
6	Hybrid with 15gm SiC	46

II. ImpactTest**:**The charpy impact V notch test was carried on impact tester. Prepare a test specimen as per ASTM D6110. The energy absorbed as determined by the subsequent rise of pendulum, is a measure of impact strength or material toughness and expressed in terms of Joules. The impact values that are obtained from the experiment are shown in the following tabular column.

3. Hardness values of composites

The hardness test was carried out on Shore hardness equipment for the specimens that are prepared as per ASTM test method designation is ASTM D2240. The indentation on the specimen gives the value of hardness. The hardness values of all the specimens are



S.No	Composite	Hardness
1	CSM E 450 GSM	61.32
2	E-Glass	68.44
3	Hybrid	75.21
4	Hybrid with 5gm SiC	70.24
5	Hybrid with 10gm SiC	75.24
6	Hybrid with 15gm SiC	67.12

4. Ultrasonic Test Results:

ULTRASONIC TESTING REPORT			
Ultrasonic Testing &Equipment			
Model: Einstein- II, TFT.		Manufacturer: Modosonic.	
Couplanttype: Liquid (Grease)		Cable Type: Limo to Mini Limo	
Velocity: Shear, 2700 M/Sec.		Probe Angle: 180 Degree Probe.	
Frequency: 4 MHz.	X-Off: 5 mm.	Ref gain: 33 DB.	Range: 100mm
Calibration Sheet Attached: Yes			
Specimen Details	**Dimensions(mm)**	**Observation**	**Remarks**
CSM	6.3	Thickness	-
E-GLASS	4.7	Defect	Lack of bonding
HYBRID	3.4	Defect	Lack of roving
HYBRID 5GMS	5.4	Defect	Knot
HYBRID 10GMS	4.7	Defect	Delamination
HYBRID 15GMS	3.1	Defect	Delamination

V. CONCLUSIONS

Based on the exploration of the test results the following inferences were made. In comparison with CSM reinforced polymer and hybrid composite, E-Glass reinforced polymer has higher tensile strength and hardness. In comparison with CSM and the E-glass composite, the hybrid composite have higher Flexural strength. When comparing with E-Glass fiber and CSM fiber laminate, hybrid composite laminate has higher Impact energy. So, hybrid glass fiber composites can be preferred over other composites if impact energy is critical in the application. InUltrasonic test CSM reinforced composite have low Defects compared with other composites.

REFERENCES

[1]M. R. Sanjay, G. R. Arpitha, Applications of Natural Fibers and Its Composites: An Overview. Scientific Research Publishing, Natural Resources, 2016, 7, 108-114 Published Online March 2016.

[2]R. Sakthivela, D. Rajendran, Experimental Investigation and Analysis Mechanical Properties of Hybrid Polymer Composite Plates-International Journal of Engineering Trends and Technology Volume 9 Number 8-Mar 2014.

[3]Narendra Kumar Attili, Ch. Siva Rama Krishna, Experimental Investigation and Analysis of Mechanical Properties of Chopped Strand Mat E Glass Fiber Polyester Resin & Silica Powder Composite, Journal of Machinery Manufacturing and Automation, Vol. 4 Iss. 1. PP, 1-9, Mar. 2015.

[4]Yong CAO, Yi Qiang WU. Evaluation of statistical strength of bamboo fibre and mechanical properties of fibre reinforced green composites. J Cent South UniverTechnol 2008; 15:564-7

[5]Venkateshwaran N, Effect of fiber length and volume fraction on mechanical properties of natural fibre composites. In: Proceeding of APM-2010 conference, CIPET, Bhubaneswar, India; February 2010. P. 323-6.

[6] Sanjay, M.R., Arpitha, G.R. and Yogesha, B. (2015) Study on Mechanical Properties of Natural—Glass Fiber Reinforced Polymer Hybrid Composites: A Review. *Materials Today*: *Proceedings*, **2**, 2959-2967.

[7]Sreekala M.S., George, J., Kumaran, M.G. and Thomas, S. (2002) The Mechanical Performance of Hybrid Phenol-Formaldehyde-Based Composites Reinforced with Glass and Oil Palm Fibers. *Composites Science and Technology*, **62**, 339-353.

[8]Vasishth A., Kuchhal P., Anand G., Study of Rheological Properties of Industrial Lubricants, 2014;Hindawi Publishing Corporation; "*National Conference on Advances in Materials Science for Energy Applications" Dehradun* , India Article ID 324615 ;1-5.

[9]G.Devendrarao,K.Srinivasareddy, Mechanical properties of E- glass reinforced Epoxy composite with SnO2 and PTEE.International journal of emerging research in Management and Technology, VOLUME-6,ISSUE-7.