NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 3, ISSUE 5, May.-2016

EXPERIMENTAL INVESTIGATION ON E-GLASS FIBER, FLY-ASH AND EPOXY RESIN

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ABSTRACT:
With structural properties by nature composite materials have found useful in electrical, thermal, tri-biological, and environmental applications. A composite material is nothing but the combination of the different material which is distinct in nature with recognizable interface. It incorporates of reinforcing stiffer phase and the matrix phase. The composite material is superior to either constituent material alone as it consists of perfect balances of structural properties of material included. Main reason having a phase stiffer and stronger than the continuous matrix phase is nothing but it typically has a fiber phase or a particle phase which is a principal load carrying member.

KEYWORDS: Tensile test, Compression test, Flexural test, E-glass, Fly-ash.

1. INTRODUCTION:
Main components of the composites are glass fiber, resin matrix and fly-ash and its advantageous if these components are complement to each other. Though the thin glass fibers are strong in nature, but they are also sensitive to damage. Some plastic materials are extremely versatile and tough in nature but relatively weak. But the combination of these three materials results into the material which is more useful for us irrespective of other materials. Ultimately, the choice of right fiber , resin and the proper selection of the manufacturing process used; can ensure designers today tailored the composites which meet the final requirements to use this material instead of others. The three main factors plays vital role are fiber, resin and fly-ash, detailed below.

On previous studies on this manufacturing process; a short discussion of authors who attempted to focus on fabrication of fiber reinforced composite are given by [1]. The inventors P J Herrera- Franco, LT Drzal et al after the research; have explained about each technique with their background and carbon fiber reinforced composites with their theoretical analysis. In the same way, results which were obtained for finite element analysis and photo elastic analysis have been presented [2]. DW Van Krevelen et al, have highlighted uni axial drawing, analysis of fiber spinning techniques and flow in operations.[3]. M Z Rong, et al, have focused on the detailed analysis and the relationship between optimized fiber treatment and their interfacial effect of various properties. [4]. V M Kharbari et al have presented a review on the importance of present and future utilization of FRP composites in the civil infrastructure and in service properties.

In this project main objective is to use the by product into use full product by mixing with some polymer matrix composites to develop some new materials for reduce pollution to the environment. The by-product is fly ash it is combined with E-glass fiber and epoxy thermosetting resin polymer. In this work, an attempt has been made to fabricate a hybrid composite material from commercial pure material and waste product. Short E-glass fibers are used as commercially pure material and fly ash as waste product.

2. FABRICATION OF SPECIMEN:

In the Manufacturing process of the fabrication of fiber specimen, first making of fiber piles .These were cut to into different size from the fiber cloth. The appropriate numbers of fiber plies were taken for this like eight for each. Then these fibers which are new one were weighed and in accordance with the resin, fly ash and hardeners, these parameters were weighed. To make of composite; the materials like Epoxy, fly-ash and hardener were mixed by in a bowl by using glass rod with make sure that any formation of bubbles. As failure of the material due to formation of air bubbles this trapped in matrix. In the next fabrication process a releasing film was put on the mould surface. After this sheets were coated by a polymer coating. On this a special ply nothing but fiber ply was put and proper rolling was done. Again it was coated with a resin and another kind of fiber ply was put and again proper rolling was done using cylindrical mild steel rod. Till eight alternating fibers have been laid, this procedure was continuously repeated. At last to ensure a good surface finish on the top a polymer coating is done. A light rolling is carried out with a releasing sheet was put on the top. In the next procedure a weight of 20 kg was applied on the composite and it left for 24 hrs for curing and subsequent hardening.

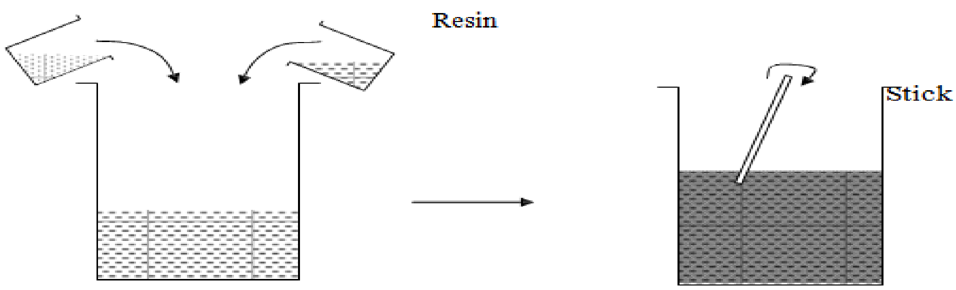

Fig2.1. A schematic representation of the mixing process

3. TESTING:

3.1 IMPACT TESTING (IZOD):

IZOD impact testing is an ASTM standard method. This testing method is used to determine the impact resistance of materials. An arm is held at a specific height and released. After releasing the arm hits the sample and the specimen and it may breaks or the weight rests on the specimen. Whatever the energy absorbed by the sample, its impact energy is determined through the tests. A sample is generally used to determine impact energy and notch sensitivity. The sample in IZOD testing is held in a cantilevered beam configuration as opposed to a three point bending configuration test.

Fig3.1 .Sample pieces of ratio 65:35

3.2 TENSILE TEST:

The characteristics of a composite are determined by the three things: first one is the matrix, second is the reinforcement and last one is the interface between them. Different reinforcement materials are available in a various forms. Common examples are continuous fibers, short fibers, whiskers, particles, etc. Density of fiber-reinforced composites is depends on the mixture which is used for composite.

$$\rho c = Vm\rho m + Vf\rho f \quad \ldots\ldots\ldots\ldots (1)$$

$$Vm = 1 - Vf \quad \ldots\ldots\ldots\ldots (2)$$

$$Vf = \frac{1}{1 + \frac{1-\psi}{\psi}\frac{\rho f}{\rho m}} \quad \ldots\ldots\ldots (3)$$

where

ρc : density of the composite
ρm : density of the matrix
ρf : density of the fibers
Vm : volume fraction of the matrix
Vf : volume fraction of the fibers
ψ : weight fraction of the fibers

Fig3.2. sample pieces of ratio of 60:40

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3.3 FLEXURAL TEST:

The behavior of materials subjected to simple beam loading is measured by the flexure test method. This method is also called a transverse beam test with some specific materials. Maximum stress and strain for fiber are measured for increments of load for the various tests and the results which are obtained; plotted using a stress-strain diagram. Flexural strength of the fiber is defined as the maximum stress in the outermost fiber. Flexural test is calculated at the surface of the specimen which is taken as sample for the experiment on the convex or tension side. While Flexural modulus; another important parameter is calculated from the slope of the stress vs. deflection curve which is obtained. To determine slope of the curve a secant line is fitted and results are calculated in case of nonlinearity of the curve.

Fig3.3. Sample pieces of ratio 70:30

3.4 COMPRESSION TEST:

In addition to tensile and flexural testing, another common form of determining the material properties of plastic (both unreinforced and reinforced) is compression testing. This test is useful for determining the modulus of strength yield stress, compressive strength, and the deformation beyond yield. The method by which the compression test shall be conducted is defined in ASTM D695.

Fig3.4 Sample pieces of ratio 65:35

4. TEST RESULTS:

4.1 IMPACT TEST:

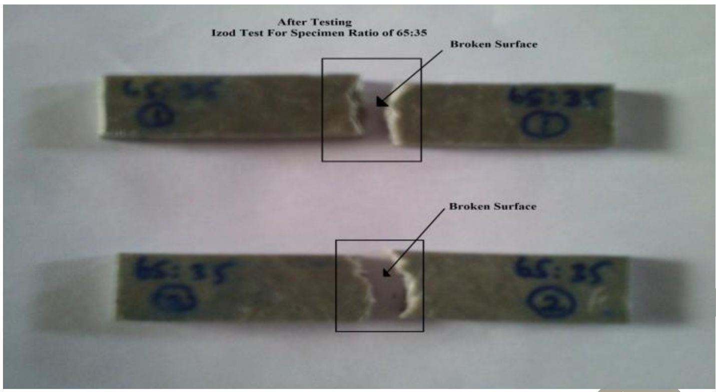

Fig4.1 Pieces after Testing the Izod Test of 65:35

Fig4.2 Izod Strength of the Specimen

Specimen	Energy gained by the specimen J	Cross section of the specimen mm^2	Strength= Energy/C.S. J/mm^2	Mean J/mm^2
60:40 1 2	0.70 0.35	$3*13*10^{-6}$	17918.72 8971.35	13161.51
65:35 1 2	0.75 0.15	$3*13*10^{-6}$	19230.77 11538.5	15381.61
70:30 1 2	0.75 0.35	$3*13*10^{-6}$	19230.77 8971.35	11102.56

Table4.1 Test results for izod test

4.2 TENSILE TEST:

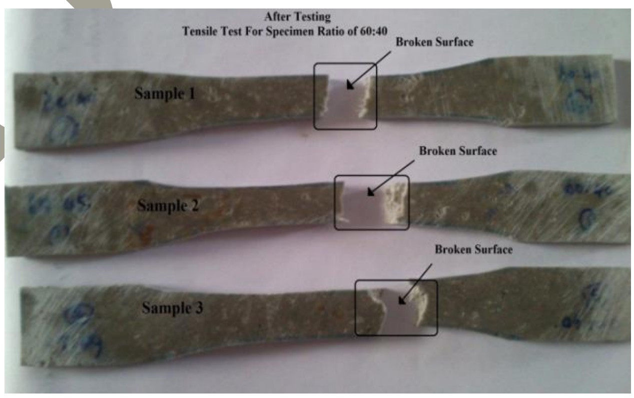

Fig4.3 After testing the Specimen at the ratio of 60:40

Fig4.4Engg Stress Vs Strain at the ratio of 60:40 Fig4.5 Load Vs Displacement Ratio of 60:40

4.2.1 TENSILE TEST REPORT:

L. M. P. R. & D. Laboratory

10/6, 5000 Suresh Complex,

PALLIPALAYAM - 638006

Batch Test Report

Test Name : TENSILE TEST	Test Type : Normal	Test Mode : Tensile
Elongation Device : CrossHead	Test Parameter : Peak Load	Test Speed [mm/min] : 2.00

Sample No.	CS Area [mm²]	Peak Load [N]	%Elongation	UTS [N/mm²]		
000001	65.000	1062.560	1.780	16.343		
000002	65.000	1538.816	1.800	23.672		
000003	65.000	1734.938	2.000	26.693		
000004	65.000	1221.247	2.000	18.786		
000005	65.000	1724.833	3.000	26.536		

Summary Report :

	CS Area [mm²]	Peak Load [N]	%Elongation	UTS [N/mm²]		
Min	65.000	1062.560	1.780	16.343		
Max	65.000	1734.938	3.000	26.693		
Avg	65.000	1456.479	2.116	22.406		
Std Dev.	0.000	302.836	0.505	4.661		
Variance	0.000	91709.711	0.255	21.724		
Median	65.000	1538.816	2.000	23.672		

Tested By ____________ Authorized Signature

Approved By ____________ Authorized Signature

4.3 FLEXURAL TEST:

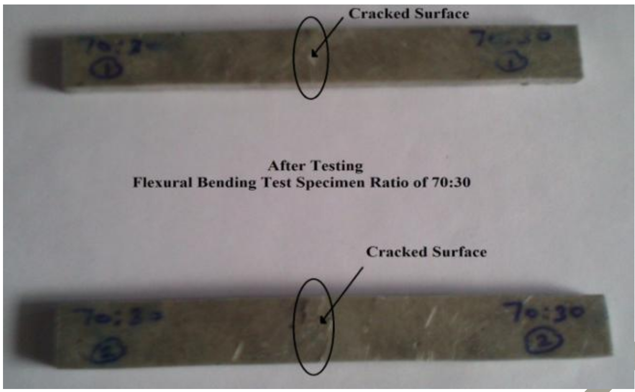

Fig4.6 Flexural Test report for Specimen Ratio of 70:30

4.3.1 FLEXURAL TEST REPORT:

L. M. P. R. & D. Laboratory

10/6, 5000 Suresh Complex,

PALLIPALAYAM - 638006

Batch Test Report

Test Name : BENDING TEST	Test Type : Normal	Test Mode : Compression
Elongation Device : CrossHead	Test Parameter : Peak Load	Test Speed [mm/min] : 2.00

Sample No.	CS Area [mm²]	Peak Load [N]	Flexural Strength (MPa)	Flexural Modulus (GPa)		
000001	65.000	215.859	62.765	176.841		
000002	65.000	165.436	48.104	3194.524		
000003	65.000	51.287	14.913	475.359		
000004	65.000	109.470	31.831	394.228		
000005	65.000	290.660	84.515	5318.192		

Summary Report :

	CS Area [mm²]	Peak Load [N]	Flexural Strength (MPa)	Flexural Modulus (GPa)		
Min	65.000	51.287	14.913	176.841		
Max	65.000	290.660	84.515	5318.192		
Avg	65.000	166.542	48.426	1911.829		
Std Dev.	0.000	92.709	26.957	2270.757		
Variance	0.000	8594.960	726.660	5156339.392		
Median	65.000	165.436	48.104	475.359		

Tested By ____________ Authorized Signature

Approved By ____________ Authorized Signature

4.4 COMPRESSION TEST:

Compression testing is another common method to determine the material properties of the plastic (both unreinforced and reinforced) like tensile and flexural testing. The modulus of elasticity, yield stress, compressive strength, and the deformation beyond yield all these parameters can easily determined by using this test. The compression test method is defined in ASTM D695.

After performing various test we proposed the following equipments are well suitable for the compression testing to ASTM D695. These are First one is two 50 mm (2 in) diameter hardened-steel compression platens mounted on a tensile testing machine, second one is our compression fixture S1931A, and last is nothing but a strain measuring device such as an AutoX 750 attached directly to the specimen. System compliance can affect test results, so in case of the stiff specimen used a strain measurement device is often required. Our Materials Testing Software "Bluehill 3" allows you to set the different parameters such as desired test control, automatically calculate the desired results and statistics, and produce a test report.

4.4.1 COMPRESSION TEST REPORT:

L. M. P. R. & D. Laboratory
10/6, 5000 Suresh Complex,
PALLIPALAYAM - 638006

Batch Test Report

Test Name : TENSILE TEST	Test Type : Normal	Test Mode : Tensile
Elongation Device : CrossHead	Test Parameter : Peak Load	Test Speed [mm/min] : 10.00

Sample No.	CS Area [mm²]	Peak Load [N]	%Elongation	Stress[N/mm²]	Strain	Break Load [N]
000001	75.000	9436.886		0.000	0.000	
000002	75.000	12596.305		0.000	0.000	
000003	75.000	8701.244		0.000	0.000	

Summary Report :

	CS Area [mm²]	Peak Load [N]	%Elongation	Stress[N/mm²]	Strain	Break Load [N]
Min	75.000	8701.244		0.000	0.000	
Max	75.000	12596.305		0.000	0.000	
Avg	75.000	10244.812		0.000	0.000	
Std Dev.	0.000	2069.404		0.000	0.000	
Variance	0.000	4282431.712		0.000	0.000	
Median	75.000	9436.886		0.000	0.000	

Tested By ____________ Authorized Signature   Approved By ____________ Authorized Signature

5. CONCLUSION

With respect to the results that have been discussed above it can be concluded that the glass fibers reinforced with epoxy polymer have exhibited a significant strength and Machinability properties and hence are suitable for use in many of the aircraft structural applications.

From results and discussions the following conclusion are drawn

i. The surface modification have an influence on the impact strength of composites . The impact strength of the ratio of 65:35 hybrid polymer matrix composites sample improved to 10-15% than that of the remaining samples.

ii. Since the ratio of 60:40 mixture fiber removed the surface impurities from the fiber, better mechanical interlocking between fiber and resin developed and hence the adhesion characteristics got. It is observed that the hybrid ratio of 60:40 increases the tensile modulus and tensile properties other than the remaining combinations.

iii. It is observed that the flexural load increased from 90N to 180N for the ratio of 60:40, 65:35 and 70:30.Flexural strength increased in the samples of 70:30 from 20 to 35% increased and it is an interesting note that the hybrid polymer matrix more shrinkage and toughness that inbuilt the chemical strength between fiber and the matrix. The 70:30 ratio samples have 30% higher flexural strength than the remaining ratio of samples.

iv. It was observed from the graph the ratio of 65:35 has the sustainable increment in the volume compressive strength of the hybrid polymer matrix composites as compared with the other specimens. It was found that the maximum level of fiber volume increase the compressive strength in the hybrid polymer matrix.

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