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Synthesis and Testing's of Walnut Shell Reinforced with Fibre Glass Polyester Resin

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Abstract: A composite consists of two or more combined constituents in macroscopic level and is not soluble with each other. Currently worldwide interest in manufacturing composite materials from west industrial and agricultural materials due to increasing demands for environmental friendly material. The walnut is enclosed by the shell called as walnut shell. Walnut shell is treated as waste but because of its good mechanical strength, chemical property and abrasive nature so it is helpful for improving property and it used as reinforcement. Fabricate the specimens by varying % of weight of 0%, 5%, 10%, 20%, 30% and 40% walnut shell flour used in polyester resin and applying resin with E-Glass fiber by using hand lay-up method. The test is carried out to determine flexural strength of composite material, Electrical Conductivity and further hardness test is conducted.

Keywords: walnut shell flour, polyester resin, bending strength, shore D durometer and electrical conductivity.

I. INTRODUCTION

There is increasing demand for advanced materials with improved properties, aiming to meet new requirements or to replace existing materials such as metals-based ones. This quest has significantly contributed to the advancing new composite materials that allowed major design improvements and found extensive application in the manufacture of a different type of products. Polymeric based composites materials are being used in many applications such as automotive, sporting goods, marine, electrical, industrial, construction, household appliances, etc.

Composite material is a macroscopic combination of two or more distinct materials, having a recognizable interface between them. Composite laminate is a combination of fiber and resin mixed in proper form. One of the unique properties of composite laminate is that it has high specific strength. Composites are being utilized as viable alternatives to metallic materials in structures where weight is a major consideration, e.g., aerospace structures, high speed boats and trains. Fiberglass is a composite material consisting of glass fibers in a matrix of polyester and epoxy. The glass fibers as purchased are woven into cloth, which is categorized by weight per square yard, type of weave, and type of glass.

II. OBJECTIVES

The objectives has been proposed below

1. Preparation of specimens by using walnut shell flour.
2. Specimen preparation involves matrix used as polyester resin with varying % of wt. by 5%, 10%, 20%, 30%, 40% walnut shell flour.
3. By using hand lay-up technique specimens are prepared as per the ASTM standards for flexural (D-790) test and hardness (D-2240) test specimens.
4. Flexural test, electrical conductivity test and hardness tests are been carry out.

III. MATERIALS FOR SPECIMEN PREPARATION

Walnut shell flour

The mainly walnut shell is biodegradable material, treated as waste. The dry walnut shells are powered by crushing action. The macroscopic structure is about < 0.25 macron. The walnut shell flour is in the form of flour. It is having good mechanical and chemical property about various applications.

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Fig 1.Walnut shell flour

Gelcoat

Glecoat is acted as high quality surface finish. This is mainly of thermosetting polymer .it is used for appliying primary process of fabricating in FRP composites. the composition of gelcoat is

Preparation of gelcoat per kg

Pigment mixing 2% to 3%

Accelerator mixing strilling (MAKP) 2%

Fig 2.Gel coat

Polyester resin

The polyester resin is used in industries because it is having low cost and having good mechanical, chemical properties. This is the thermosetting plastic resins. This polyester resin helps to gives good strength for composite material.

Fig 3.Polyester Resins

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Polyester resin is of two types they are General Purpose (GP) and Fire Resistance (FR). This is the most commonly used polyester resin because of its availability and lower price but it gives good strength while fabrication.

Hardener

The hardener is the like curing agent for the resin in the specimen preparation. In the specimen preparation the hardener is used as MEKP (Methyl Ethyl Ketone Peroxide).

Chemical formula	$C_8H_{18}O_6$
Appearance	Colourless Liquid
Density	1.170g cm^{-3}
Boiling point	Decomposition beyond 80°C(176° F)

Fig 4.Properties of MEKP

Fig 5.Hardener MEKP

E-Glass fiber mats

. The E-Glass fiber made with different type of GSM (glass surface mat) like surface mat 30GSM, 300GSM, 450GSM will be using. These fibres are of mainly using for electrical purpose with resisting characteristic. By combined emulsion of different resins to give high stiffness to the fibre.

Fig 6.Cutting mat for required size

The basically E-Glass mats are in the form of rounded bundle and that bundle is to cut as per the required shape and size for users.

III. PROCEDURE FOR SPECIMEN PREPARATION

The preparation of samples is fabricated by using hand lay-up method. The specimens preparation is consist of different stages.

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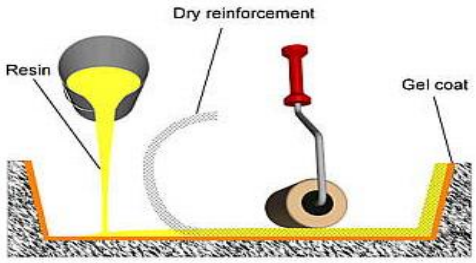

Fig 7.Hand lay-up technique

Step 1 matrix preparation

For specimen preparation matrix is using as polyester resin. The polyester resin is mixed with fine walnut shell flour and mix well. After adding WS flour stirrer properly of 2 to 3 min. The polyester resin main drawback is to resist temperature up to 170°F. Only to know the property of polyester resin reacted with walnut shell to give strength to the specimens while fabricating.

To improve the property of matrix becomes good because of bonding of matrix and E-Glass fibres are rigidly taken over in specimen preparation. Only in the changing the composition of walnut shell flour with varying % of wt. 5%, 10%, 20%, 30% and 40%.

Fig 8.Walnut shell flour mixed with polyester resin

Step 2 Fiber reinforcement mat

The E-Glass fiber is used in specimen preparation because of gives strength to the specimen preparation. The fibers are made up of glass material with different type of GSM (grams per square meter). It is most used for electrical insulating material.

The three type of mats are using in to specimen preparation it is 30 GSM single layer of surface mat and 300GSM of layer mat and 400 GSM one layer mat is used for flexural and marine test. For hardness test it requires 30 GSM single layers of surface mat, 300GSM two layer of mat and 400 GSM three layer of mat is using. The E-glass fiber mat uses different GSM.

Justification – The different GSM mat is use to fabricating specimen because matrix properly mixes with low 30 GSM layer mat. After the 300 GSM and 450 GSM mat is used for fabricate and also having advantage of this is

1) Get good surface finish.
2) Reduce unnecessary air bubbles and also free from air bubble.
3) Specimens are fabricating as per the adjustable thickness.

Step 3 Specimen fabrication

The specimen preparation chooses the plane surface as a mould. Surface should be cleaned with thinner. Preparing gel coat is applied for required area. After applying Gel coat leaving for curing.

1) After curing single layer of matrix is applied and places the 30 GSM of surface mat on the matrix surface. Again apply the matrix on the surface mat smoothly with a help of brush.

2) After completing the matrix apply then 300 GSM of one layer of mat will be applied with applying matrix is used between the mats. Also cut the mats with required size and apply

3) The completing for apply single layer of 300 GSM mat is used the two layer of 450 GSM mat is used for back for specimen preparation.

4) By Appling the matrix to the mat, use the screw roller to remove air bubbles from specimen preparation, because it creates cracks and damages to the specimens.

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4) After 30-45 min this is get cured and hard, same process is repeated for other specimens. By vary the density of matrix of %of wt. 5%, 10%, 20%, 30% and 40% make specimens for same process. To know the colour variation in specimen preparation varying the %of wt. using walnut shell.

5) By finishing curing the specimens removed from mold and subjected for the cutting. The specimens are ready as per the ASTM dimension for flexural dimension.

6) By portable cutting machine it will be cut as per the required shape and size, after is segregated as per the tests of flexural test, samples for sea water and hardness test.

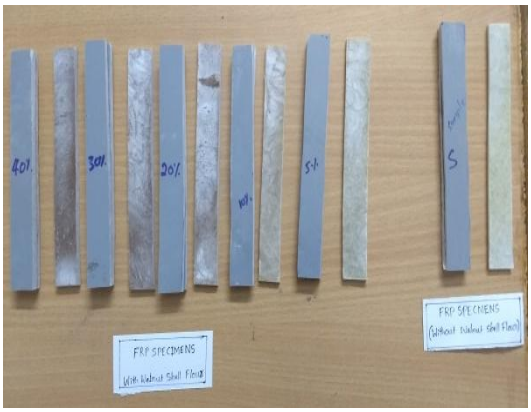

Fig 9.Specimens for flexural test

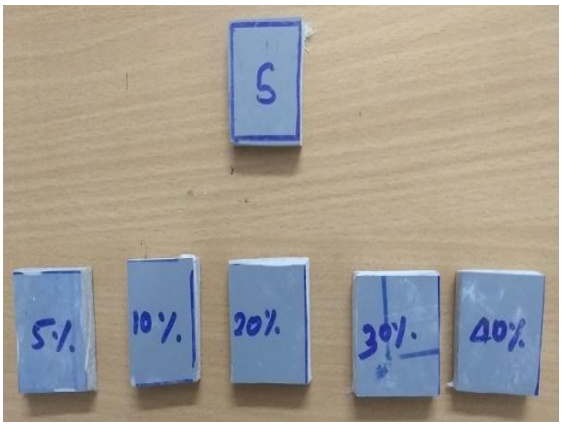

Fig 10.Specimen for hardness test

Fig 11.Specimens for electrical conductivity test

IV.RESULTS AND DISCUSSION

Hardness Test

The hardness tests involved to know hardness property in the composite material. The hardness test conducted by equipment called as shore D durometer. The composite specimens are made as per the ASTM D2240 standards of 25×25×6 mm

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Average values for hardness test

Sr No	Original sample	5% WS	10% WS	20% WS	30% WS	40% WS
1	61	68	71	75	77	75
2	58	70	75	74	78	79
3	60	72	70	76	79	73
4	62	73	73	78	75	83
5	56	67	74	77	81	80
Average	**59.4**	**70**	**72.6**	**76**	**78**	**78**

Fig 15: Average hardness values

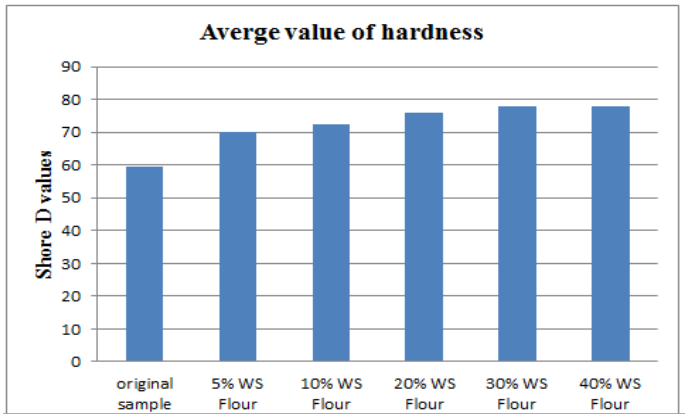

Fig 16: Average hardness value

Flexural Test

The flexural test is carried out to know the strength of materials while bending. This test is needed to find the capacity for resisting by the load. For flexural test specimens are as per the ASTM standard D790-02.

Average results for flexural test of specimen

Specimen Composition	Train No	Bending strength in N/mm^2	Average In N/mm^2	Bending Modulus in N/mm^2	Average In N/mm^2
Resin (without WS flour)+30gsm +300gsm+450gsm+450gsm	1	750	749	17.24×10^3	17.78×10^3
	2	865.38		20.60×10^3	
	3	634.61		15.52×10^3	
Resin (with 5% of WS flour)+30gsm +300gsm+450gsm+450gsm	1	634.61	538.78	19.67×10^3	16.02×10^3
	2	519.23		14.88×10^3	
	3	461.53		13.52×10^3	
Resin (with 10% of WS flour)+30gsm +300gsm+450gsm+450gsm	1	807.69	750	36.50×10^3	35.46×10^3
	2	692.30		34.18×10^3	
	3	750		35.71×10^3	
Resin (with 20% of WS flour)+30gsm +300gsm+450gsm+450gsm	1	1153.84	1057.78	66.88×10^3	57.83×10^3
	2	1038.46		53.25×10^3	
	3	980.76		53.37×10^3	
Resin (with 30% of WS flour)+30gsm +300gsm+450gsm+450gsm	1	1673.0	1557.66	178.46×10^3	165.64×10^3
	2	1442.30		137.36×10^3	
	3	1557.69		180.60×10^3	
Resin (with 40% of WS flour)+30gsm +300gsm+450gsm+450gsm	1	1269.23	1153.84	96.703×10^3	84.17×10^3
	2	1038.46		74.844×10^3	
	3	1153.84		80.971×10^3	

Fig 12.Average Results

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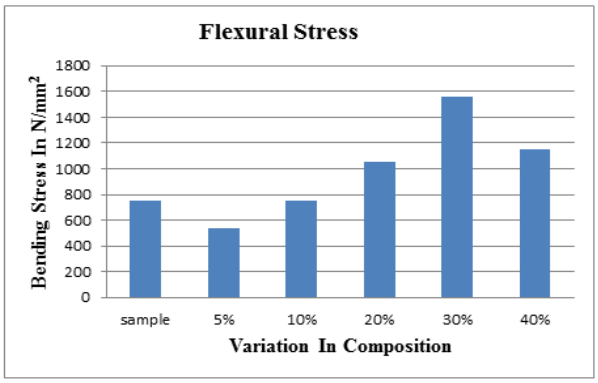

Fig 13: Comparison of different flexural strength

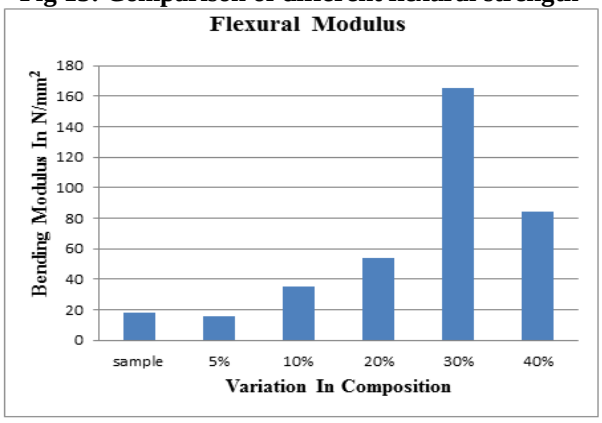

Fig 14: Comparison of different flexural modulus

Electrical conductivity of composite

The testing setup will be conducted on the basis of Maggers Instrument, on the basis of the experiment conducting the test to know the specimen material should give the current resistance for the specimens.

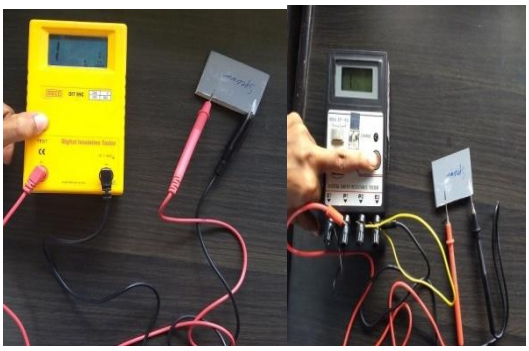

Fig 17: Average hardness value

Fig 18: Average hardness value

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Let, V = I×R

V= Voltage
I= Current in Ampere (A)
R= Resistance in ohm (Ω)

$$R = \frac{V}{I}$$

$$R = \frac{50}{0}$$

R= ∞ or Unit MΩ

For all specimen samples are shows the unit MΩ reading

The electrical conductivity is the shows material characteristic for composite specimens and the specimens of 5%, 10%, 20%, 30% and 40% adding walnut shell flour and subjected to electrical conductivity test. The resistivity test result shows the resistivity of 1MΩ. The specimens are resisting the electricity and show the bad conductor. It is helps to make electrical resistance components.

V. CONCLUSION

From the experimental results are concluded that

1. By bending test for original sample to different WS flour contained samples are compared with result. The original samples are low bending strength compared to WS contained sample for different compositions up to 40% but this bending test only 30% will give good bending strength for specimens.
2. Hardness test is concluded that composite specimens of six samples are tested with help of shore D durometer. The original sample result shows the lower the hardness and WS contain specimen samples are shown the higher the hardness values for different composition values.
3. The electrical conductivity test is shows the FRP composite specimens are the tested. By all testing result for composite materials act as good insulating material. For all FRP specimens are shown 1MΩ resistivity also supply the 220v to the specimens but it shows the zero current supply.

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