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Study and Preparation of Polymer Based Hybrid Composite from Used Tablet Strips and Jute Fiber with Epoxy as Matrix

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Abstract: Non decomposable wastes are dumped into the society. As a part of waste management medical wastes are taken into consideration towards recycling. Alu-alu foil a type of aluminium composite that are used for tablet packaging has some flexibility is used to make hybrid composite. These aluminium strips in the form of granules and jute were reinforced into epoxy LY-556 matrix material which is a thermosetting high temperature tooling resin used in industries that are adhesion to variety of substrates. The combination of these components could be used as an alternative for the light weight furniture products. The use of a non-bio degradable waste material that is equal to some wooden components.

I. INTRODUCTION

Composite material is a material made from two or more constituent material which significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual component the new material may be preferred from any reason. Jute and aluminum film are the reinforcement particles of the nature reinforced hybrid composite. To bond these, a high temperature tooling resin has been selected (epoxy ly 556 and hardener hy 951) to make a bond with jute and aluminum films as they have different nature and a unmatched properties. With these materials the composite is made according to ASTM standard for polymers with hand layup technique and physical tests are done.

II. LITERATURE SURVEY

1.Bhabatosh Biswas et.al studied Mechanical Behaviour of Aluminium Dispersed Unsaturated Polyester/Jute Composites for Structural Applications.(2016)

The fibrous filler Jute along with Al particle reinforced unsaturated polyester composites having different filler (both Jute and Al were in equal wt%) were fabricated by compression molding technique. The scratch result shows the optimization of strength and toughness of the composites with filler content of 10 wt%.

2.Tazbiul Mahmud Aranno et.al done Fabrication, experimental investigation of jute fiber reinforced epoxy composites and hybrid composites.

A special type of jute fiber woven mat was introduced by a hand loom. Epoxy jute fiber composites were fabricated using the woven fiber mat. A series of jute-hybrid epoxy composites based on the arrangement of the direction of jute fibers, and additional material were introduced to ensure the elevated mechanical properties of the composites. Improved mechanical properties were found in some cases of hybrid epoxy composites.

3.G. Kalusuraman et.al : Use of waste copper slag filled jute fiber reinforced composites for effective erosion prevention(2019)

This work addresses the erosion performance of waste copper slag filled jute fiber reinforced polyester composites. The composites are prepared by two different fiber treatment methods such as sodium hydroxide (NT) and calcium hydroxide (CT) and the results are compared with the specimen prepared by untreated fiber (UT). The desirability analysis was performed and found that the CT composite with impingement angle at 90 and jet velocity at 86.36 m/s could achieve lower erosion rate. 4.Priyadarshi Tapas Ranjan Swain et.al: Influence of fiber surface treatments on physico-mechanical behavior of jute/epoxy composites impregnated with aluminum oxide filler (2017).



4.Priyadarshi Tapas Ranjan Swain et.al: Influence of fiber surface treatments on physico-mechanical behavior of jute/epoxy composites impregnated with aluminum oxide filler (2017).

The present paper discovers the effect of ceramic filler inclusion on physico-mechanical and water absorption behavior of untreated and chemically treated (alkali and benzyl chloride treated) bi-directional jute natural-fiber-reinforced epoxy composites. The investigational result reveals that chemically treated composites considerably improved the mechanical properties of the composite. The maximum water absorption resistance and strength properties were found with benzyl chloride-treated fiber-reinforced composite.

5.Hadi Rezghi Maleki et.al :Experimental study on drilling of jute fiber reinforced polymer composites (2019)

Drilling is an essential machining operation that is frequently performed for making of holes in composite structures to facilitate assembly of several components into a complex part. The literature reviews indicate that only a few of research articles investigated drilling of natural fiber reinforced composites. The experimental results indicated that the most significant effect was the drill bit type influencing both delamination factor and surface roughness.

Material selection:

Jute gunny

Jute is a long, soft, shiny important natural based fiber that can be spun into coarse, strong threads. Jute fiber is basically lignocelluloses, biodegradable, and renewable. Owing to its high tenacity and low extensibility, it is traditionally being used for producing packaging material. It is also stiff and harsh. Taken from two varieties of the Corchorus plant, white jute and tossa jute which is softer, silkier, and stronger than white jute.

aluminium strips:

Alu alu foil is the best composite film of blocking performance at present with ultimate protection against water, oxygen and UV radiation. It is especially used for the high sensitive range of pharmaceutical and generic medicines.

epoxy ly556 and hardener hy951

Epoxy LY 556 is a medium-viscosity, unmodified epoxy resin based on bisphenol-A. Possesses excellent mechanical properties and resistance to chemicals, which can be modified within wide limits by using different hardeners as well as fillers. Araldite LY 556 has a low tendency to crystallize.

Material preparation:

Hand layup method:

It is the most traditional method of fabricating composites. At first resin is applied in the die. Brush is used to apply matrix mixed with resin on the reinforcing materials. Rollers are used to roll the materials for the uniform distribution of matrix materials over the reinforcement and to acquire required thickness. Finally the material is allowed to cure at standard atmospheric condition. This, hand layup process consists of four stages mould preparation, gel coating, layup, curing. Curing is the last stage in which the material is allowed to harden without external heat.

Methodology:

Step-1:

Die is prepared.

Step-2:

Wax has been coated

Step-3:

Resin is applied and spread equally with rollers

Step-4:

Mat is been laid

Step-5:

Resin is again applied

Step-6:

Aluminium granules are spread widely and equally all over the surfaces

Step-7:

Again the process is been repeated from step-3 until it reaches the required thickness

Preparation of samples:

Weight of jute mat of size 247*255 is 11.25 grams

Number of mat required to make a specimen of 5 mm thickness is 3



$$11.25 \times 3 = 33.75 \text{ grams}$$

RESIN ABSORPTION BY JUTE

$$W \% = (m_t - m_o) / m_o$$

W %-weight gained by the specimen

M_t-weight of specimen after time

M_o-dry specimen

$$W \% = (112.3875 - 33.75) / 33.75 \times 100$$

$$W \% = 233\%$$

SAMPLE SPECIMEN OF WEIGHT RATIO 2:1

Weight of aluminium granules= 67.5 grams

Weight of jute fiber added= 33.75 grams

Weight of resin added= 438 grams

Total weight= 539.25 grams

SAMPLE SPECIMEN OF WEIGHT RATIO 1:1

Weight of aluminium granules= 33.75 grams

Weight of jute fiber added= 33.75 grams

Weight of resin added= 452 grams

Total weight= 519.5 grams

SAMPLE SPECIMEN OF WEIGHT RATIO 1:2

Weight of aluminium granules= 18.87 grams

Weight of jute fiber added= 33.75

Weight of resin added= 412 grams

Total weight= 464.62

III. RESULTS AND DISCUSSION

Tensile test:

Tensile testing is used to measure the force required to break a polymer composite specimen and the extent to which the specimen stretches or elongates to that breaking point

ASTM D3039 tensile testing is used to measure the force required to break a polymer composite specimen and the extent to which the specimen stretches or elongates to that breaking point.

Test category	Trial test
Type of test	Tensile test
Test standard	ASTM D3039
Rate 1	2.00 mm/min
Temperature & humidity	22.1 & 57.3
Test date	14/05/2022

Sp.ID	Width [mm]	Thickness [mm]	Maximum Force [kN]	Tensile stress at Maximum Force [MPa]	Failure Mode	Remarks.
S-01 (1:1)	25.05	5.560	2.21	15.88	LGM	NA
S-02 (1:1)	25.10	5.550	2.02	14.51	Failed at grip	
S-03 (1:1)	25.08	5.620	1.32	9.34		Failed near tab
S-01 (1:2)	25.02	7.000	2.40	13.71		Failed near tab



S-02 (1:2)	25.02	7.000	2.79	15.94	LGM	NA
S-03 (1:2)	25.12	7.000	2.24	12.75	Failed at grip	
S-01 (2:1)	25.12	7.000	3.97	22.59	LGM	
S-02 (2:1)	25.12	7.000	3.86	21.94	LGM	
S-03 (2:1)	25.12	7.000	3.94	22.39	LGB	
Minimum	25.02	5.550	1.32	9.34		
Maximum	25.12	7.000	3.97	22.59		
Mean	25.08	6.526	2.75	16.56		
Standard deviation	0.04	0.71	0.96	4.73		

Hardness test:

The specimen is placed under the indenter of the Barcol hardness tester and a uniform pressure is applied to the specimen until the dial indication reaches a maximum. The depth of the penetration is converted into absolute Barcol numbers.

ASTM D2583 Barcol Hardness is used to determine the hardness of both reinforced and non-reinforced rigid plastics.

TEST RESULTS

S.NO	COUPON IDENTIFICATION	READINGS ARE IN BARCOL SCALE (B)				
		1	2	3	4	5
1	1:1	30B	25B	30B	25B	30B
2	2:1	20B	25B	25B	25B	20B
3	1:2	15B	20B	15B	15B	20B

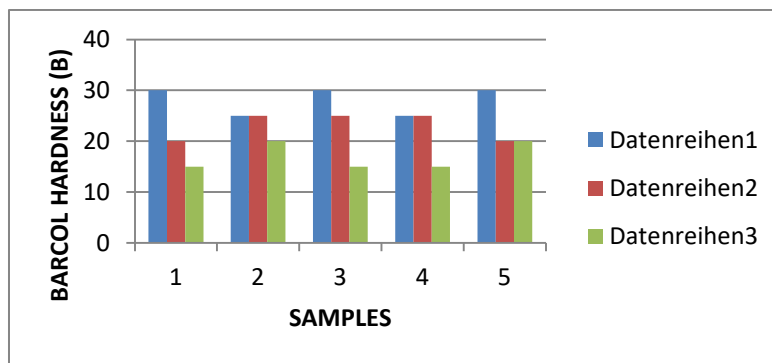


Fig no.1

Water absorption:

For the water absorption test, the specimens are dried completely and weighted and the readings were noted, and then soaked into distilled water for 24 hours then again weighted were the result values.

Formula to calculate water absorption

$$= (m2-m1)/m1*100 \%$$



WATER ABSORPTION TEST OF SAMPLE 1:1 RATIO

Sample No.	Weight of dry specimen	Weight of wet specimen	$(m_2-m_1)/m_1*100$ %	% of water absorbed
Sample 1	12.25	12.31	0.489795918	48.98
Sample 2	12.13	12.21	0.659521847	65.95
Sample 3	12.46	12.54	0.642054575	64.21

WATER ABSORPTION TEST OF SAMPLE 2:1 RATIO

Sample No.	Weight of dry specimen	Weight of wet specimen	$(m_2-m_1)/m_1*100$ %	% of water absorbed
Sample 1	17.82	17.91	0.505050505	50.51
Sample 2	17.31	17.43	0.693240901	69.32
Sample 3	18.32	18.38	0.327510917	32.75

WATER ABSORPTION TEST OF SAMPLE 1:2 RATIO

Sample No.	Weight of dry specimen	Weight of wet specimen	$(m_2-m_1)/m_1*100$ %	% of water absorbed
Sample 1	17.9	17.97	0.391061453	39.11
Sample 2	17.84	17.94	0.560538117	56.05
Sample 3	18.16	18.25	0.495594714	49.56

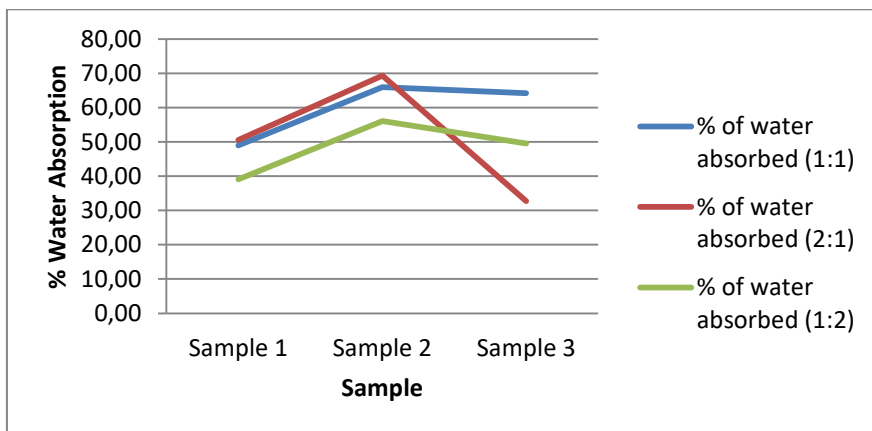


Fig no.2

IV. CONCLUSION

In this work- polymer based hybrid composite epoxy matrix and jute, aluminium granule reinforcement the specimen ratio 1:1 performs well than other specimen ratios of 1:2 and 2:1.

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