

FABRICATION AND MECHANICAL PROPERTIES EVALUATION OF HYBRID COMPOSITE OF COCONUT SHELL AND GLASS FIBER

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Abstract— In this Research paper we evaluate the Mechanical Properties of hybrid composite testing, including: prepared the mixture of Coconut shell powder and epoxy material Bond tite; reinforced material glass fiber by using hand lay-up method. The two variation of weight of coconut shell powder is taken; according to ASTM standards samples are made. In this we are testing the mechanical properties compressive strength, tensile testing and flexural properties of hybrid composite material.

It is Application of composite material Aerospace Industries, Military Industries, furniture industry, railways, building constructions, ceilings and panels, automobiles, medical industry etc. due there surprising property of light weight, cost effective, easy manufacturing, bio-degradable and environment eco-friendly materials.

Index Terms— Impact Energy, Tensile strength, Compressive Strength, Bending Strength, Strain, Elongation, Load Variations.

I. INTRODUCTION

In today's industrialization composite materials are used in various applications like interiors of vehicles, machine parts, aero- space industry, furniture industry, railways, building constructions, ceilings and panels, automobiles, medical industry etc. due there surprising property of light weight, cost effective, easy manufacturing, bio-degradable and environment eco- friendly materials. Composites are of basically two types Metal Matrices composite (MMC) and Polymer Matrices composite (PMC). In MMC the base material is metal where in PMC the base material is other than metal. In this research we use the PMC of coconut shell powder binds with epoxy resin and reinforced material is glass fiber, it's a hybrid composite material.

Coconut shell is the by-product of coconut fruit which is waste after using coconut water and meat. Coconut shell is available abundantly in tropical areas like south states of India. It is natural fiber used in making various composite materials. Coconut shell used as small particles made by pulverizing mills. Main properties of coconut shell are light weight, cheap,

hardness, high compressive property, bio-degradable, easily available in nature.

Reinforce material is glass fiber; this is synthetic fiber materials easily available in market in different forms like thread, wool and woven form. Reinforcing is done for binding the two materials tightly. Our first material is coconut shell powder and other is epoxy resin, the glass fiber is placed between these two in woven form.

The final hybrid composite material is based on coconut shell powder reinforced with glass fiber in woven form. It has mechanical properties like high compressive strength, tenacity, high hardness, non-corrosive and better flexural properties and physical properties if this hybrid composite is light – weight, low density, manufacturing cost is low and eco- friendly.

Application of this hybrid composite is in plastic industry, plastic furniture making, interiors of automobiles and engine covers, aero-space industry like panels and ceilings, laminations, building constructions etc.

A. What is the “Coconut Shell Powder?”

The Coconut Shell Powder are those material is naturally materials Constitutes Ecological Problems and need has arisen to reuse these materials Economical viable values.



Figure 1. 1.Coconut Shell powder

The Coconut shell Powder is waste by Products of the Industry and Agricultures processing that the material of the coconut shell Powder is Naturally Materials and the Economical viable values.

B. What is the “Epoxy material?”

The Epoxy is a material Comprised of Two or Moure material separated component darker and hardener Component must be blended at the right Proportion's to create through chemical Reactions a strong Plastic that is useful as a durable flooring of Composite materials.



Figure 1.2 Epoxy Liquid Material

This is Epoxy Paint is Formed When a Mixture of one part peroxide resin and other parts as polyamine hardener. That is the hardener acts as a Catalyst just to give a strength of the Epoxy of the in the materials.

C. What is the “Reinforced Glass Fiber?”

The Reinforced Glass- Fiber Composite material is composed of axial particulates embedded in matrix materials.



Figure 1.3 Glass-Reinforced Fiber

The objective of the Glass-Reinforced fiber obtains a material with high Specific Strength and high Elastic modulus for its weight. The strength is obtained by having the applied load transmitted from the matrix to the fiber.

D. What is the “Material?”

The material is defined as the substance of physically Properties and dimensions Length, Height, width, Area, Volume, of the materials (most often as like Solid, Liquid, and Gas but there is other condensed phases can be Included) that is intended to be used for certain Applications.



Figure 1.4 Physically Materials

The Materials is the Physical substance used to make things All the Materials that used into the Manufacturing of a finished bulk Even through. It may not be Present in final product of the hybrid Composite materials.

Like Materials, Plastics, Ceramics, Glass, and Fibers are some of the main Categories for materials.

E. What is the “Composite Material?”

Two or more chemically different Constituents Combined Macroscopically to yield a Usefully Materials. Physically properties and dimensions with Images presented in this thesis of the hybrid composite material coconut shell Powder based composite.

Two or more chemically different Constituents

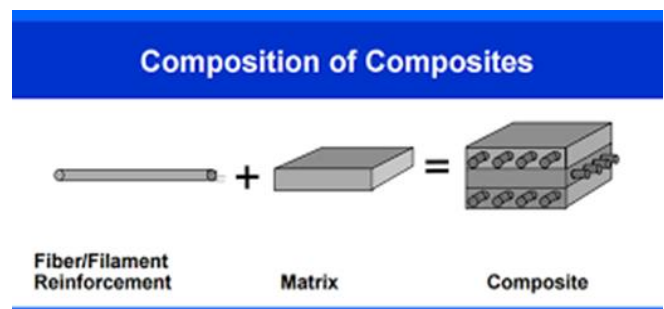


Figure 1.5 Compositions of Composites

Combined Macroscopically

Properties of final Product should be significant ally different than that of Composite Material.

F. What is the “Hybrid Composite?”

Hybrid Composites material are Consistent of Two the Molecular level commonly one of these compound is inorganic and the other one organic in Nature.

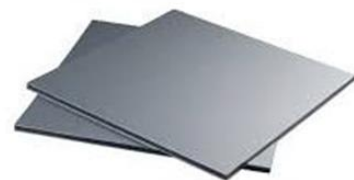


Figure 1.6 Hybrid Composite pieces

Thus they different forms Traditional Composites where the Constituents' are at the Macroscopic level mixing. Scale leads to the more homogeneous mixing hybrid Composite materials.

G. Experimental set-up and manufacturing of the Specimens of Hybrid Composite material

In this Experiment of the thesis work in used to the main we use the coconut shell powder as in powder and Glass fiber form which is made by hand grinding and mixture machine. Coconut shell powder is air dried under presence of sun light for

1.1 Table for the Materials Quantity

S. No.	Coconut shell powder(wt.)	Reinforced Glass Fiber	Epoxy resin
1	20 gm.	Woven form	100 gm.
2	35 gm.	Woven form	100 gm

Removing its moisture content in a beaker Epoxy resin mix well by hand stirring and mixes it with coconut shell powder and mix well with spoon hand stirring for the all three samples.



Figure 1.6.1 specimens making

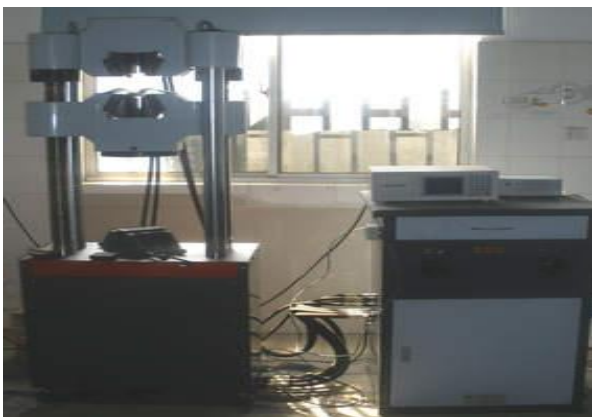


Figure 1.6.2 tensile strength teste set-up

We have main three samples therefore 9 specimens' standard testing According to ASTM Standard Parameters and Indian Standard and ISO According to Machining of specimens' dependent on different- different testing specimens required different – different Parameter and shape of the Specimens to find Out the Standard Mechanical physical Properties of the Composites material.

1.2 Table for Specimen size

S. No.	Size in mm
1	165 × 19
2	76 × 25
3	63.5 × 12.5

II. LITERATURE REVIEW

Moe Mathew and Kin Liao

[1] Presented a study on the effect of environmental aging on mechanical properties of bamboo- glass fiber reinforced with polymer matrix hybrid composites. In this thesis work bamboo and glass fibers were used as reinforcement with polymer matrix hybrid composite polypropylene(PP) and malefic anhydride polypropylene(MAPP).For this compression moulding was used as fabrication method and after fabrication tensile testing and flexural testing were done on fabricated composite.

Andrej k Bledzki et al

[2] Carried out a study on barley husk and coconut shell reinforced with polypropylene composite for Thermoplastics as alternative or together with wood fibers. In this study the composite is fabricated by injection moulding with high speed mixer and then they derived the physical and chemical property of fabricated sample by SEM for particle size investigation and also show the water absorption property of the fiber to evaluate the chemical composition.

Siddhartha k. Pradhan et al

[3] presented a study on coconut shell particle(CSP) and ultra high molecular weight polyethylene (UHMWPE) thermoplastic polymer, prepared by powder metallurgy and carried study with three different composition of 20%, 30%, 40% by volume and notch impact test, fractal graph test and mechanical properties are displayed. Study gives the better preliminary results of UHMWPE CSP composite. At 20% - 30% of CSP composite show good toughness but compressive strength decreases beyond 20% of CSP.

J Olumuyiwa Agunsoye et al

[4] Studied CSP reinforced with polymer metric composite (PMC), a natural lignocelluloses. Composite is fabricated by compacting low density polyethylene metric with 5% - 20% of CSP. Coconut shell dried in open air and grinded in pulverizing

machine according to BS1377:1990 Standard powder and polyethylene is in palletized form. Results shows the hardness of composite increases with CSP content where as tensile strength, modulus of elasticity, impact energy and ductility of composite decreases with increase in CSP content. SEM indicates the poor interfacial interaction between CSP and low density polyethylene matrix.

L. V. J. Lassalle et al.

[5] Studied the effect of water absorption for short term in glass fiber reinforced composite (FRC) on the flexural properties of composites. For the study of flexural properties the unidirectional E-glass fiber is reinforced with polymer matrices with different water Absorption properties. Rhombic polymer and FRC test specimen is prepared by three commercially available resins (Sinfony Activator, Triad Gel, 3M Scotch bond Adhesive) and different volume fractions of fiber and test carried out by 3-point bending test after 30 day water storing. In this flexural strength varies from 759Mpa to 916Mpa of specimen with 45% Volume fraction of E-glass.

R. Udhaya Shankar and B. Karthikeyan

[6] Were presented a study of coconut shell with different binders and also classified different types of natural fiber. Coconut shell is natural fiber bio-composite and available easily and bio-degradable too. It has various application such as in packaging industry, agriculture, medical, sportswear, for insulating, coating, in interiors of automobile, furniture's etc. Natural fiber has advantages like low cost, low density, corrosion resistance, good specific strength properties and reduced tool wear.

K. Gunasegaram et al.

[7] Investigated the mechanical and bond properties of coconut shell concrete (CSC). Coconut shell is used as coarse aggregate and ordinary Portland cement of 53 grades is used to make a composite with two different water-cement ratios. Pull out test is carried out to determine the strength of CSC. Experimental bond strength of CSC is much higher than the bond strength estimated by BS 8110 and IS 456:2000, comparative test. Compressive, flexural strength, splitting tensile strength, impact resistance and bond strength measured. CSC is light weight concrete and has better workability because of smooth surface on one side of the shell had the size of CS used in study. This study proves that coconut shell full fill the requirement for use as aggregate material in concrete mixture.

III. EQUIPMENTS USED

Table 3.1: Required Materials for the experimentation

S. No.	Materials used	Requirements
1	Coconut shell Powder	Molecular Level
2	Epoxy + Resin	Liquid colourless
3	Reinforce Material woven Glass Fiber	woven form

Coconut shell powder- The Coconut Shell Powder are those material is naturally plant based fruit cover coconut shell materials Constitutes Ecological Problems and need has arisen to reuse these materials Economical viable values.

Epoxy + Resin- The Epoxy is a material Comprised of Two or More material separated component darker and hardener Component must be blended at the right Proportion's to create through chemical Reactions a strong Plastic that is useful as a durable flooring of Composite materials.

Reinforce Material woven Glass Fiber- The Reinforced Glass- Fiber woven form Composite material is composited of axial particulates embedded in matrix materials. The thesis work and of Hybrid composite material the objective of the Glass-Reinforced fiber obtains a material with high Specific Strength and high Elastic modulus for its weight.

The strength is obtained by having the applied load transmitted from the matrix to the fiber.

Table 3.2: Required equipments for the experimentation

S. No	Equipments	Quantity
01	Weighting Machine	01
02	Runner control.	01
03	hopper	01
04	Getting	01
05	Position Ruler	01
06	Alarm	01
07	Safety Door	01
08	Oil Tank Inside	01
09	Flow motor	01
10	Electric box	01
11	thermometer	01
12	tray	03
13	Hand cutter	01
14	Specimens	09
15	Testing Specimen	09
16	Tensile Strength	03 Test
17	Compressive Strength	03 Test
18	Bending Strength	03 Test
19	Elongation	03 Test
20	Stress/Strain T. M	03 Test
21	Impact Energy	02 Test
22	Hardness	03 Test

A. CNC lathe machine OR Hand Cutter:

The CNC machine Making the used of simple machining used to the According to American Society testing material (ASTM) Standard.

B. Specimen Machining:

Improperly prepared test specimens often is the reason For unsatisfactory and incorrect test Results. It is important, therefore, that care be exercised in the Preparation of specimens, particularly in the machining, to maximize precision and minimize bias in test results. Specimens making

according to ASTM and ISO Standard testing of Experiment in Properties Find out the hybrid Composite Materials Specimens preparations According ASTM Parameters.

C. Machining Cutting of Specimens:

Machining of Specimens cutting force range of 1.4KN to 2.7 KN associating these with power from 5KW to 20KW given Cutting Speed from 215m/min to 450m/min

The Speeds in the range 100 to 1000m/min are indeed practical for turning Speed and Cutting Tools made from Cemented carbide

D. Materials Find Out:

According to ASTM (American Society for Testing and Materials), grain size Number, defined as Molecular level coconut shell powder and woven glass fiber and Epoxy + Rein hybrid composite materials.

$$N = 2^{(n-1)} \quad (A)$$

Where N = is the of Number of grain per Square inch visible in a prepared Specimens at 100 x and n is the ASTM grain Size Number Low ASTM Numbers mean a few massive grain- high Numbers refer to many Small grains.

E. Testing Specimens:

Within the limitations of material availability and economy, the specimens shall be sized large enough to be statistically representative of the material to provide meaningful data and, where possible, large enough to affix strain gages or extensometers.

Gage lengths incorporating deformation-measuring devices shall be at least 13 mm (1/2 in.) in length. Testing of Specimens According ASTM Find out properties of mechanical.

F. Hardness Testing Machine:

Hardness testing of properties in Specimen prepare According to ASTM

G. Tensile Test Testing Machine:

Calculate the ultimate tensile strength by dividing the maximum force by the average cross-sectional area from and reporting to three significant figures. Tensile strength shall be reported in MPa.

H. Tensile Strength Testing Machine:

A tension specimen is mounted in the grips of a mechanical testing machine and monotonically loaded, in tension, at a constant loading rate until specimen failure occurs. The ultimate strength of the material can be determined from the maximum force carried before failure.

Power: 18 Watt

Frequency: 50 Hz

Motor Phase: Three Phase

Voltage: 165-240 AC

Electricity supply: 1 Phase, 220 V AC, 6 k

I. Experimental set-up and manufacturing of the Specimens of Hybrid Composite material

In this we use the coconut shell as in powder form and woven Glass fiber and third materials Epoxy + Rein material used in this thesis work which is made by hand grinding and mixture Machine. Coconut shell powder is air dried under presence of sun light for

Table 3.3. Materials mixture Quantity

S. No.	Coconut shell powder(wt.)	Reinforced Glass Fiber	Epoxy resin
1	20 gm.	Woven form	100 gm.
2	35 gm.	Woven form	100 gm

Removing its moisture content of the coconut shell powder in a beaker Epoxy + resin mixture well by hand stirring and mixes it with coconut shell powder and mixture well with spoon hand stirring for the all three samples



Figure. 3.9.1 Melting in low Temperature



Figure 3.9.2 Raw composite Mixture Machine



Figure 3.9.3specimens making

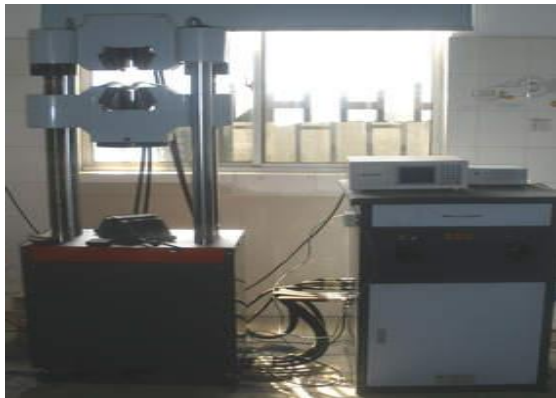


Figure 3.9.4 tensile strength test set-up

We have main three samples therefore 12 specimens' standard testing According to ASTM Standard Parameters and Indian Standard and ISO According to Machining of specimens' dependent on different- different testing specimens required different – different physically dimensions and sizes of the hybrid composite material specimens Parameter and shape of the Specimens to find Out the Standard Mechanical physical Properties of the Composites material.

Table 3.4 Hybrid for Specimen size

S. No.	Size in mm
1	165 × 19
2	76 × 25
3	63.5 × 12.5

And some of used Testing Methods in the Hybrid Composite Material in this Project Experiment Specimens is making in According different-different testing in Parameters and different – different Parameters sizes of Specimens.

IV. RESULTS

In this the Thies in Working of the Hybrid Composite Material Making of New composite in used materials Coconut shell powder and Epoxy + Resin and other used in the Project Experiment Reinforcement material woven Glass Fiber used in binder of form in Research Article main prepuce of in growth an Indian composites fields increasing the composite material and reduces the cast of the composite materials products. This is the composite material Coconut shell powder and epoxy material in strong Bond; reinforced material woven glass fiber. All the Result in found Standard of the composite materials

Table 4.1. Properties of hybrid composite

Mechanical Properties	Experimental Values
Tensile Strength (MPa)	21.3606
Compressive Strength (MPa)	1.428
Bending Strength (MPa)	28.1006
Strain	0.114
Elongation (mm)	11.3726
Impact Energy (kg.cm/cm)	20.2653
Hardness	74.54

V. CONCLUSION

From the result obtained after the experiment and thereafter by its analysis i.e. the comparisons of mechanical properties, thermal properties, and chemical properties of the Coconut shell Wood Powder material and Epoxy + Resin Liquid and third material Reinforced Glass Fiber woven form material, composite materials values of present in tables in properties. The improvement of the Hybrid composites material quality physical properties of material and Applications of Hybrid composite materials in Aerospace Industries, Aircraft Industries, Aeronautics Industries, Marine Industries, Electrical industries, Electrical Industries, and underground wire ring, this is Composite material is corrosion resistant.

Also the values obtained are as per the requirement of a composite material to be used as a substitute of the conventional of Coconut shell Wood Powder material and Epoxy + Resin Liquid material with reinforced Glass Fiber woven form material, composite material i.e. naturally occurring of the hybrid composite material.

VI. FUTURE SCOPE

The work can further be improved by using different types of materials is Hybrid Composite material based on Coconut shell Powder and Epoxy + Resin Liquid material ceramic glass fiber sheet: based composite materials is higher Applications of in Aerospace Industries, Aircraft Industries, Aeronautics Industries, Marine Industries, Electrical industries, Electrical Industries, design of Aircraft Structures' Bodes, Aircraft doors, Aircraft sheets, Furniture's and underground wire ring, this is Composite material is corrosion resistant. Light weight

material there several of material such as composite materials which are further sub-divided into different types thus Coconut shell powder Naturally and Epoxy + Resin Liquid material the hybrid composite material Glass fiber based composite materials processes Fabrication and Mechanical characterization of the hybrid composite material.

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