

# Mechanical Properties of Reinforced Epoxy Composite Using Waste Coconut Shell Charcoal

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**Abstract** – In this study Coconut shell charcoal uses as traditional material where high tensile strength, light weight, low thermal expansion, excellent mechanical properties, environment friendly low-cost composite because charcoal found without cost naturally. Take clean coconut shells, crushed, produce in powder form, dried in sunlight and burn closed furnace without air and find carbonized charcoal form, epoxy resin and Gardner is in weight ratio 10:2 and mixed with 5, 10, 20 % coconut charcoal powder, avoid the air bubble in mixing process then make specimen turn on lath for standard shape and tensile test, bending test on the universal testing machine.

**Key Words:** Coconut shell charcoal, hardener, epoxy, composite

## 1. INTRODUCTION

The increase of the environmental awareness issues playing an important role to encourage the industry to produce products using eco-friendly material, reducing the Carbon dioxide emissions. Natural fibers composite such as coconut shell composite more attractive due to their high strength, light weight, less density, and they are ecological and eco-friendly. The fiber production method is eco-friendly at all levels. The goods used for its revolution are up to 99.70% recycled. West Carbon fiber like jute and groundnut shell, coconut shell etc. fiber of composites for superior mechanical properties, environment friendly, low cost composite because charcoal found without cost. naturally Carbon fiber replace traditional material like aluminum magnesium and improve mechanical and tribological behaviors use in challenging high performance design component. [2] Material may be a dissimilar metal or other material and give exclusive properties it result on mechanical properties such as tensile strength thermal strength specific density flexibility. [3] The reinforcement is one type of matrix, reinforcement material is mixed into the matrix. The reinforcement used to modify physical and mechanical properties, tribological performance, such as wear behaviour, friction coefficient and thermal conductivity. [4,5] Fibres or particles set in a matrix of a new material are the most excellent example of modern-day composite materials, which are typically structural [9] In Indus valley civilization the first application of reinforced composites, which is from of straw, brick After 2nd world war Britain replaced material aircraft, used aluminium alloy composite, flax fibre composite. [20] Material of coconut shell fibre is less

density it means weight ratio low, save the weight of composite that is a potential advantage. Coconut shell is easily available at lower cost and easy processing. [21] In Composite of fibres problem examine is very difficult. Because. Because of the combination of crack propagation in directions parallel and perpendicular.

## 2. DESIGN AND APPLICATION

The design procedure set up with determining the functional requirements of the component or get-together being designed. the carbon fibre composite for a product that is high performance, high-cost issues The robot arm is created by Carbon fibre composite materials then result found in robot arm lighter, less expensive and faster. In car manufacturing focus on light weight and material used which reduced the effect of greenhouse gas, Design steering wheel, knuckles front end bumpers side panels engine block door modules and floor panels with carbon fibre. Design of aircraft achieves by making a composite, Apply this technology in aircraft structures, helicopters, spacecraft missiles Design of submarine is challenging because it is designed to reach 3600 feet under sea that is ocean deepest point so, categorized by advanced feature for special operation. and challenges for extra research because requirement high lighting trains indicate that are light weight and capable at the same time as not compromising on safety, performance or comfort.

## 3. LITERATURE REVIEW

[1] Study Rahul Shrivastava and Amit Telang use Coir and Glass Fiber Epoxy Resin for preparing composite and study mechanical properties of this Hybrid Composite. That research and focus on naturally occurring resources for carbon fiber, charcoal because environment awareness resources developed now a days there is a growing research on composites that is Natural fiber reinforced polymer and apply to design high performance component. Properties of polymer Fiber reinforced composites superior that is biodegradability, weight low, manufacturability easy, strength, high weight ratio low, production with low cost, etc. so this natural carbon fiber replace traditional material like aluminum magnesium. Due to all these properties, composite has considerably for challenging high performance design. Utilized technique to advance the mechanical properties as reinforcement

[2] Study by Abdul Khalil epoxy composites: with biomass-based use carbon black as filler raw material which is prepared from the coconut shells bamboo stem, and oil palm empty fibre bunch, this filler carbon fiber available by fast and cheap method that improve the base material properties and characterized such that high strength low weight or electrically conductive materials, Filled composites dramatically change the polymer matrix to improve greatly the properties of the base materials. in composites use requires and attractive quantity of this bio-resource based Carbon black.

[3] Study Padmaraj N H composite materials that is Bio fiber based Coir Areca Husk fibers and were reinforced with unsaturated polyester resin ,the manufacture of composites has special properties higher tensile flexible strength , low weight ratio , low density , easy processing and cost low,. Due to these superior properties is use in the high performance engineering applications, prepared reinforced unsaturated polyester resin composite with Areca Husk and Coir fibers and study. Prepared Specimens and tested for bending strength, tensile strength, , impact strength and hardness as per individual ASTM standards. The results in comparison in all properties improve performance where specimen of areca husk fiber reinforced explains over specimens of coir fiber reinforced. However the specimens of hybrid composite test outcome show usual values as compared to individual fiber reinforced composites. Results, availability of areca husk fiber, coir fiber, that is available with low cost so, consider alternative material for filler in composite replace traditional material

[4] study A.K. Rana composites use filled as jute fiber for reinforced polypropylene, that is use in shock modifier and fiber loading and filler addition to composites are decreasing tensile, flexural properties. Increase, decrease toughness rise with modifier. Notched, unnotched Izod impact, flexural and tensile strength, modulus analyzed with different modifiers study impact modifier Effect and both impact and tensile properties showed increasing tendency with the compatibiliser. Effect of shock modifier on fiber loading, increase in fiber loading with rise impact strength. Study the fiber surface, fiber sketch out and line of fiber polymer.

[5] study by Sahas Bansal Composites of Fiber Reinforced Polymeric use as filled Coir, Bamboo, and Jute this Natural Fiber Reinforced Polymeric composite us natural fiber as filler because natural fiber available in large quantity easily available and free of cost so, economical because bio based waste material and have superior chemical composition like Lingo cellulosic result of test have excellent mechanical properties and recyclable because of this properties and easy processing natural fiber replace traditional and synthetic fiber used as reinforcement for natural fiber reinforced polymeric composites.. study and prepare of composite of epoxy resin and filler as jute fiber bamboo fiber, and coir fiber

and analyzed results in FTIR test Impact test, Hardness test and Rockwell test and compared this test result with epoxy resin bamboo-coir composite and epoxy resin bamboo-jute composite shows bamboo epoxy resin better result.

[6] Study Ashik 2018, natural and glass fibre reinforced hybrid composites, analyze moisture absorption and mechanical properties natural fibre reinforced for design of high performance engineering application. The natural carbon fiber totally renewable, eco friendly, specific strength high, low cost non-abrasive, biodegradability. Conclude different media the moisture absorption test and mechanical test such as flexural, impact strength using ASTM standards test methods. by hand layup technique make specimens use filler as different natural carbon fiber and analyze properties

[7] Study Sudarshan Rao (2015), reinforced epoxy composite filler as natural carbon fibre graphite particulate analyze Erosive wear behaviour, study erosion behaviour of filled and unfilled graphite particulate ,solid Unfilled. Study Erosive wear decrease or increased at different percentage graphite filled composite;. The surfaces was observe erosion mechanisms discus

[8]study Merve soganciogluand manufacture of the epoxy composite with the paralysis charcoal of washed PET ,effect of product with paralyses temperature epoxy resin and charcoal wt. and assessment mechanical properties for example tensile strength, elongation at break, surface hardnessat different temperature and weight, at different temperature performed as charcoal in the production of epoxy composites and test. Reduce cost while improving the properties and behaviour by using some waste material in preparation of composite Epoxy composite material showed the ideal behaviour.

[9]. Study Hari Om 2015 epoxy composite with filler the short sisal fibre by synthetic fibres advance mechanical properties that is traditional material replaced by natural fibres has several reimbursement and unique properties such as low density high specific mechanical performance, ecofriendly, at low cost so, Examine short sisal reinforced epoxy composite tensile, flexural and impact properties, and great improvement experiential in impact properties by sisal fibre. The mechanical testing was achieve on short sisal epoxy composite.

[10]. Study Akindapo, mechanical behavior of rice husks carbon fiber and groundnut shell carbon fiber as reinforcement in epoxy matrix examine their mechanical properties such as impact , bending and tensile strength hardness, were evaluated. The highest mechanical behavior of the groundnut shell matrix epoxy composites while the highest mechanical properties for the rice husk reinforced epoxy composite

[11]. Study Muhammad Khairy Reinforced Epoxy Composites with Oil Palm Fiber, waste types Oil palm

fibres is high cellulose fibres that is research on Chemical behavior of Fibers. Design in high performance industries components, examine and analyze the increase of reinforced untreated and treated epoxy composites filler as oil palm carbon fibre., mechanical properties analysis on specific tests and standard effect

[12]. Study Ajith Gopinath 2014 Jute carbon Fiber Reinforced Epoxy Composites with Polyester analyzed superior Mechanical Properties like lightweight low density, high stiffness, Composites manufacturing in comparison fiber composite better than synthesizing composites. Study the fiber reinforced composites were ready with epoxy and jute polyester. The prepared and tested of composites result show bending strength, tensile strength and hardness, better in composite of jute fiber than composite of Jute-polyester.

[13] study Onkar v.potadar 2018 epoxy and coir fiber composite with waste groundnut shell and coir fibers as filler carbon fiber .preparation and test composites analyze the batten the coir fiber and groundnut natural carbon fiber composite. Carbon fiber Composite materials replace traditional material because superior properties, thermal expansion low, tensile strength high and bending strength high and weight ration low. Groundnut shell polymer composite and coir composite is a natural fibre composite in different shape analysis tensile strength, moisture absorbent and high specific strength, lightweight.

**4. METHODOLOGY**

**Used Material**

- a. Coconut shell
- b. Hardener
- c. Epoxy resin

**Powder of Coconut Shell**

During the formation powder, the cleaned coconut shells used and cut into little pieces by utilizing hammer. This pieces of coconut shell grounded into powder form by an utilizing a crusher after that ball processing. The performance of influencing RCS powder appears in figure



Figure.4.A. Procedure of making raw coconut shell powder

A coconut shell charcoal mould of 270mm long and 25mm diameter is shown in fig. 3.C. (i) was the mould for casting the matrix composite specimen. A Fiber mould was utilized for casting the composite cylinder. The presentage weight of coconut shell charcoal powder (ie. 5, 10, 20 weight %), were blended with the reinforced material

consisting of epoxy resin and hardener in the proportion of 10:2. Care was taken to stay away from development of air bubbles occur throughout pouring. The applied pressure was from the top and the mold was permitted to treat at room temperature for 12 hrs.



(i) Making Mold Specimen (ii) Circular Specimen for bending test (iii) Making Rectangular Specimen

**Turning of Specimen for Tensile Testing**

After the casting of specimen, the composite specimen found and has a cylindrical shape having a 25mm diameter and 270 mm length.



**Bending Strength Testing** The estimate length (L), and diameter (D) in mm of specimen 110 mm and 25 mm



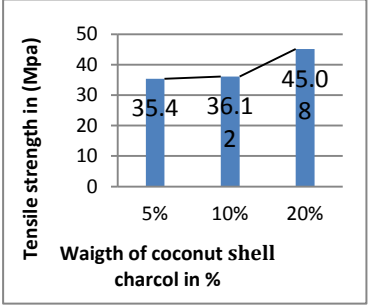
Tensile Test On Utm

Bending Test ON UTM

## 5. RESULT AND DISCUSSION

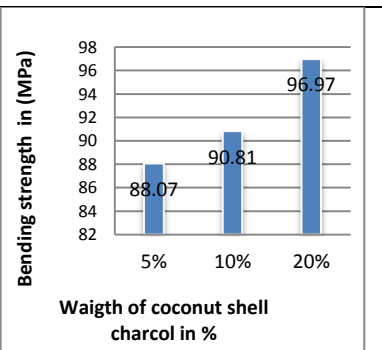
**5.1. Tensile Strength:-** The cylindrical specimen in examples is used for the tensile test.

% Volume of charcoal	Ultimate Load (N)	Tensile Strength (Mpa)
5%	5450	35.40
10%	5560	36.12
20%	6940	45.08



**5.2. Bending testing:-** Bending test was going to on D2344-84. Examples of 20mm wide and 150mm long.

% Volume of charcoal	Ultimate Load (N)	Bending Strength (MPa)
5%	3860	88.07
10%	3950	90.81
20%	4250	96.97



### 5.3 Density of coconut shell charcoal fiber specimen:-

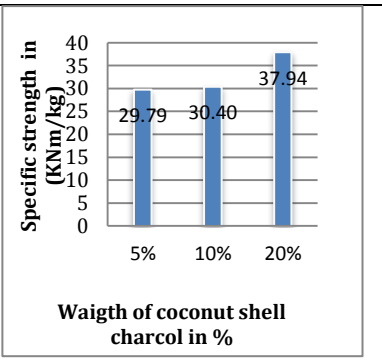
In density term of measurement of coconut shell charcoal fiber specimen dimension 115mm length, 16mm width and 16 mm thickness having weight 35gm by using weight machine.

Dennsity=1.188 gm/cm<sup>3</sup>

### 5.4 Specific Strength:-

The sp. strength is define as the ratio of material's maximum strength and its density. It means strength/weight ratio.

% Volume of charcoal	U. tensile strength (MPa)	Specific strength (KN·m/kg)
5%	35.40	29.79
10%	36.12	30.40
20%	45.08	37.94



## 6. CONCLUSIONS

Study and analysis of mechanical properties of the composite for filler material such as waste coconut shell charcoal prepared with Epoxy Composites. The specimen made by mixing of 5 %, 10%, 20% weight of coconut shell charcoal.

Proximate analysis of coconut shell particles concedes that due to carbonization effect the fixed carbon content was increased from 5 % to 10%, 20%. The most tensile strength and bending strength is acquired for the composite arranged with the 20wt % carburized coconut charcoal particulate filled epoxy composite.

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