



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 7, July 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569



9940 572 462



6381 907 438



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A Review on Mechanical and Physical Properties of Coconut Shell Powder Reinforced Polymer Composites

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ABSTRACT: The mechanical properties of coconut shell reinforced polyethylene composite are being evaluated in order that it should function a brand new material for engineering applications. Coconut shell reinforced composite was prepared by compressing denseness polyethylene matrix with coconut shell particles and also the effect of the particles on the mechanical properties of the composite produced were tested. The result shows that the hardness of the composite increases with increase in coconut shell content. But the enduringness, modulus of elasticity, impact energy and ductility of the composite decreases with increase within the particle content. A poor interfacial interaction between the coconut shell particle and therefore the rarity polyethylene matrix was observed. This study therefore portrays coconut shell powder as another particulate material for the event of a replacement composite.

KEYWORDS: coconut shell powder epoxy resin and hardener.

I. INTRODUCTION

Over the last thirty years, composite materials, plastics and ceramics are the dominant emerging engineering materials. the quantity of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. The day to day wastes which include shell of various dry fruits, rice husks, wheat husk, straws and hemp fiber are often accustomed prepare fiber reinforced polymer composite for both domestic and commercial use. they're basic interest thanks to their vast applications and advantages from the purpose of low weight and fiber matrix adhesion. Existing polymers are mainly blended with different materials with the aim of cost reduction and tailor the merchandise for specific applications. Environmental regulations have powered the rummage around for materials that are environmentally friendly. A pressing issue in Nigeria today, is that the recycling of waste products and other agricultural by-products suitable for the invention and characterization

of new materials. Annually, approximately 33 billion coconuts are harvested worldwide with only 15% of those coconuts being utilized for fibers and chips. this implies that there's considerable room to cut back this type of environmental pollution and enhance the efficiency of using natural resources [1].

In previous few years, there has been enormous attention on environmental friendly materials which will reduce the burden on the ecosystem and construct a more sustainable lifecycle. within the field of composite materials, natural, biodegradable materials are studied widely to interchange conventional composites fabricated with thermoplastics and engineering fibers, e.g., glass fiber/ polypropylene. the rise in fossil energy cost has accelerated the speed of development of such composites with competitive mechanical properties[5].

It is one among the essential staple to be embedded with CMC to develop an environmental friendly product. Every single a part of this economical plant will be which provides foods from its fruit and soft trunk, water and oil from its fruit, roof and broom from its leaves, and bridges from its benefited trunk. Furthermore, in construction sector, timber and wood is replaced by coconut trunk because the main structure. Husk, leaves and shell of coconut may be

being employed as low cost materials since they're called agriculture waste products [17]. Scientists and researchers are within the midst of earlier research and development to search out better energy sources like gas, steam, crude oil, etc. But researchers are looking constantly for structural materials in today's world that may transcend the restrictions of current traditional materials. this is often because all the available energy sources perish at a lightning pace that has now begun another period of saving our rapid depletion[15].

II. COCONUT SHELL POWDER REINFORCED POLYMER COMPOSITE

The coconut shell was dried and grinded into coconut shell powder, the powder was sieved accordance with BS1377:1990 standard. Fig 1 and Fig 2 show the coconut shell and its particle forms. 100 g of the coconut shell powder was placed into a gaggle of sieves arranged in descending order of fineness and shaken for 15 min which is that the recommended time to appreciate complete classification of the particles, the particle which can be retained below BS. 100 m was utilized in this study. Metal molds were utilized in the assembly of the composite samples. Each mold includes a cavity to accommodate the composite samples. the size and shapes of cavities were made in keeping with the scale and shape of the samples as per ASTM Standard D 638-90 for tensile testing and ASTM Standard D 790-97 for impact test (ASTM). Epoxy, hardener and so the coconut shell particles were mixed during a container and stirred for 5–7 min. Before the mixture was placed inside the mold, the mold was polished with a release agent to forestall the composites from sticking onto the mold upon removal. Finally, the mixture was poured into the mold and left at temperature for 24 h until the mixture hardened. When the composite is hardened, it had been removed from the mold. Studies on the morphology of the coconut shell particles, epoxy matrix and thus the composites were administered employing a SEM, model Leica Cambridge S-360. Charpy impact strengths of the specimens (120 mm×10 mm×4 mm) were determined with an impression tester (Cheng teh China, Model JC-25 4J). The tensile strengths and tensile modulus were measured using Instron machine (model 5564) with a strain rate of 0.002 S⁻¹, at temperature, in keeping with ASTM D 638-90. Test samples were 3.5 mm thick, 6.0 mm wide and 60 mm long [2].

III. MECHANICAL PROPERTIES OF POLYMER COMPOSITES.

3.1. Tensile properties

Tensile strength of a cloth is that the ability of the fabric to resist tensile forces applied either sides of the specimen. The test is employed to work out the lastingness and young's modulus of the fabric. Fig 3 shows the results of durability. For this test Universal Testing Machine (UTM) is employed. Using this machine with suitable jigs, most mechanical tests are performed by this machine to figure out the material properties. Fig 4 shows the everyday UTM in working. in keeping with ASTM standards, the composite specimen was prepared for tensile testing to figure out the material properties. All the required dimensions of the specimen are entered into the pc along with the utmost load and displacements are assumed and entered. After the failure of the specimen, the pc shows the Load Displacement curve[14].

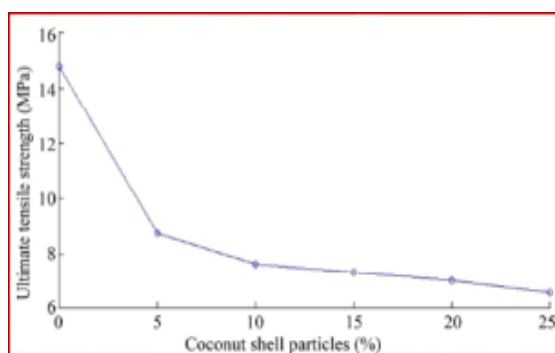


Fig 1. Tensile strength of coconut shell reinforced polyethylene composite

3.2 Impact properties

From Fig 5, the impact energy of the composite creases with a rise in coconut shell particles content within the matrix of the polyethylene coconut shell reinforced composite. The sample with 25% volume fraction coconut shell particles within the matrix has all-time low impact energy of 1.76J.

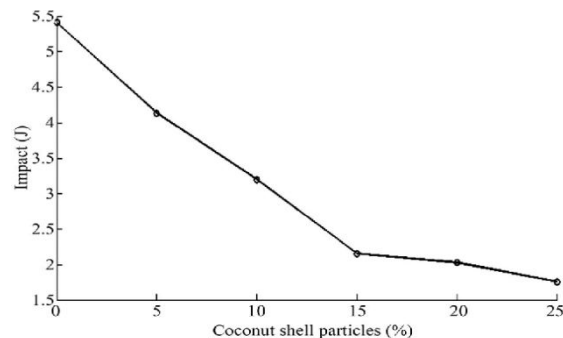


Fig 2. Effect of coconut shell particles addition on the impact of coconut shell reinforced polyethylene composite.

3.3 Density Density could be a measure of mass per volume. the common density of an object equals its total mass divided by its total volume. Densities of the compacted samples of known weight were determined from Equation(1). $\rho = m/v$(1)

From Fig 6, because the filler increases, the porosity of the composites decreases. The water absorption is due to the hydrophilic nature of the coconut shell.

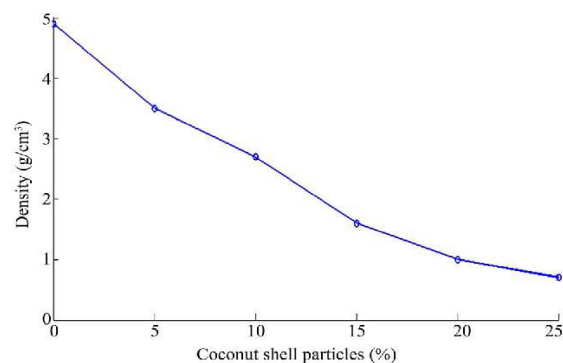


Fig 3. Effect of coconut shell particles addition on the density of particulate coconut shell reinforced polyethylene composite.

3.4 Compressive properties

Cylindrical (150mm in diameter x 300mm in height) specimens were tested using digital compression consistent with ASTM C39. The load was applied such the strain increases at a given constant rate until failure. the utmost load was recorded and also the value was divided by the cross-sectional area of the specimen to get the compressive strength of stuff. the common compressive strength of three cylinders for every batch was taken[15]. 3.4 Modulus of elasticity Cylinders measuring 150mm in diameter and 300mm tall were wont to find the modulus of elasticity of composite material. The specimens were loaded up to 40% of the final word load as per ASTM469[15].The modulus of elasticity was calculated using formula Eq. 2: $E = (S_2 - S_1) / (\epsilon - 0.000050)$ where E = chord modulus of elasticity (MPa). S2 = stress comparable to 40% of the final word load (MPa). S1 = stress similar to the longitudinal strain of fifty x 10⁻⁶ (MPa). ϵ = longitudinal strain produced by stress S2.

IV. PHYSICAL PROPERTIES

4.1 Corrosion resistance

Polymer composites will be designed for excellent corrosion(somewhat of a misnomer)resistance to specific hostile environments. Much emphasis must be placed upon the choice of an appropriate resin system when designing against a hostile chemical environment. However, attention to the main points of design is required to make sure that optimum performance is achieved. Good corrosion resistance isn't just achieved by selecting an optimum resin. the entire manufacturing process, installation and repair life, must be optimized. Composite materials are highly anisotropic and this ends up in more basic mechanical properties being required for a basic characterization. additionally, their high anisotropy complicates the test methods and offers different properties in tension, compression and shear.



4.2 Thermal conductivity

It is also important for the thermal conductivity of composites to work out conditions for warmth flow. conductivity to thermal Properties are independent from direction and might be calculated under conditions of both steady state and transient heat flow. In fact, transient methods are determinations of the thermal Diffusivity, which can be the thermal conductivity Derived[11].

Polymers are applied to antistatic agents to decrease their tendency to draw in power. Controlling static control in some plastic production and processing, electricity is important. Operations for handling, moreover as finished goods. The Static Plastics charges can generate shocks, present fire hazards Dust and attract it.

4.3 Crystallinity

It is well-known that the crystallization process plays a vital role on the properties of semi-crystalline polymers which the presence of carbon fibers as reinforcement may also affect this process. However, the pictures obtained by polarized light optical microscopy during this work don't show any evidence of nucleation under the cooling rates performed, when analyzed within the range of 0.5 to twenty °C/min. Also for the slowest cooling, because it are often seen, the crystal growth appeared to happen in a very homogeneous manner. While the formation of PPS crystallites was highly homogeneous, a special behavior was observed for the cooling performed at 5° C/min.

The very low thickness of the produced polymer film allowed the depiction of crystallite nucleation on the microfilament surface thanks to the creation of a bubble on the surface of a carbon fiber microfilament. it's assumed that nucleation detection was only possible thanks to the film thickness, as there was no overlapping of crystallites. additionally, the event of crystals tends to evolve in an exceedingly very homogeneous way, as before. A transcrystalline coating may be seen on the carbon fiber base, thanks to nucleation. Such a phenomenon wasn't visualized off from the fiber on the bubble boundary, which eliminates the probability that the layer generated was the results of the existence of the bubble.

4.4 Morphology

The fractured surface morphology of the samples was analyzed using an EM-30AX scanning microscope. The morphology analysis of polymer intercalated clay nano composite is incredibly much important to know the feel, nature, fracture mechanism and toughening properties of polymer composite. Aliphatic diamine has been used as a curing agent in epoxy/intercalated clay nano composite.

The scanning electron and tapping-mode atomic force microscopy is employed to review the fracture surface topology. the morphological properties like fiber breakage, fractured fringe of fiber, fiber pull out, dislocation of fiber and orientation of the fiber of every tested specimen and matrix because of mechanical

V. CONCLUSION

During this study we understand that the Mechanical properties-tensile strength and modulus of elasticity was closely associated with physical property-density. Decreasing value of density would be due to poor adhesion, direct contact of shell particles and void formation. This decrease of density resulted into decrease of tensile properties. Increase of wt% of reinforcement requires pressurized fabrication technique or addition of any adhesion increasing additive. Increase of proportion of particle size but 200µm would be helpful to extend density furthermore as tensile properties.

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