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Study on AL_2O_3 doped coir fibre based composites

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Abstract
The aim of this work is to study the physical, mechanical and water absorption behavior of coconut fiber reinforced epoxy composites filled with Al_2O_3particulates. Composites with different structures were created by varying the length and shape of the fibers using the hand layering technique. Experimental research showed improved properties of the composite material. It can be seen that the density of composite materials increases with the incorporation of Al_2O_3 particulates it can be seen that the density of composite materials increases with increasing fiber content, whereas the density decreases with increasing fiber length.

Keywords: epoxy, coir fiber content, fiber length, mechanical properties Al_2O_3 particulates

Introduction

Natural fiber composites or biocomposites are defined as composite materials made from biodegradable natural fibers as reinforcement and a biodegradable or non-biodegradable polymer matrix. Currently, natural fibers such as coconut, jute, kenaf, sisal, flax, pineapple fiber, etc., are widely used for the production of composites, as they are readily available as a renewable resource, Low density, easy processability, light weight, high density, high specific gravity, recyclability, low cost and overhead, "equivalent" bitrates [1]. Natural fiber reinforced thermoplastic composites are popular in mounting plates, paneling, fencing, furniture and construction applications, as well as in the packaging industry with limited drawdown [2]. The low density of natural fibers allows the creation of composites that combine respectable mechanical properties with a low specific mass. The growing attention to the use of natural fibers is well-known among researchers and technologists. Many support extensive research efforts in the field of natural fiber reinforced composites Authors have demonstrated that natural fibers are excellent alternatives to potentially toxic synthetics [3]. Natural fiber focused on here is coconut, a fruit fiber obtained from the coconut tree (Cocos nucifera) [4]. They are widely produced in tropical countries. Due to its durable quality, durability and other advantages, it is used in the production of various floor furniture products, Rope, twine, etc. However, these ancient coconut products only use a small portion of the world's potential coconut palms. From now on, As indicated above, research and expansion efforts are underway to explore new application areas for coir, beyond the common use of coir to incorporate its use as reinforcement in polymer composites. The low cost and high performance of coir is suitable for industries while its biodegradability contributes to a healthy ecosystem.

However, coir is an inconvenient reinforcement due to some special physical properties. The hydrophilicity of coconut is very unfavorable as its overall performance is concerning, mainly due to its poor bonding with the hydrophobic thermoplastic matrix. As reinforcement, choir skills can be developed Improves the interfacial bonding between coconut fiber and polymer matrix. This can be achieved by modifying the topology of the system or by selecting appropriate components of the bonding system. Surface modifications of natural fibers like jute and coir fiber mechanical properties of the resulting composites are enriched as we recently suggested. Several employee attempts have been made to modify coconut fibres for possible use in polymer composites. However, research in this area of polymer science and technology is still in its infancy. And then it takes a lot of analytical techniques and effort to realize the full commercial value. In this experiment, coconut fiber was used as the polymer matrix for lignocellulosic and PP polymer blends. Polypropylene (PIP) treated and used in normal temperature applications has improved physical, mechanical and thermal properties. And Wood Plastic Composites (WPC) occupies a large percentage in the market.

Aluminum oxide Al_2O_3, commonly referred to as alumina, is the most economical and widely used material in engineering ceramics and has the potential to be used as filler in various polymer matrices. It is hard, wear-resistant, has high strength and toughness, excellent dielectric properties, and is resistant to attack by strong acids and alkalis at high temperatures. With its excellent combination of properties and reasonable price, it is not surprising that the applications of high-quality technical grade alumina are very wide [5].

The incorporation of nanofillers through advanced manufacturing techniques has improved fiber-reinforced composite materials by modifying fiber and matrix interactions [6, 7]. Nanofillers have enormous potential to improve the mechanical performance of composites, thereby increasing their applications in numerous fields. The homogeneous and uniform nanofiller structure improves the mechanical, thermal, and tribological properties of the composite [8, 10]. Nanofillers are usually inorganic and sometimes organic; the most common inorganic nanofillers are alumina, magnesia, silica, zinc oxide, titanium dioxide, and calcium carbonate; naturally occurring organic nanofillers include synthetic clays, carbon black, and cellulosic fibers. The optimal amount of nanofillers varies depending on the filler, matrix, and fiber type. When building pillars, free space in the room is very important, especially when gluing laminate stiffeners. The filler acts as a bridge between the matrix and the fibers, increasing the interactions between them. Once a load is applied, the stress is easily transferred from the polymer matrix to the reinforced fibers, greatly improving their mechanical performance. The addition of nanofillers affects the curing process of the epoxy matrix; this effect depends on the size and concentration of the nanofillers in the matrix. The curing speed of the epoxy matrix decreases due to the increased filler content and smaller nanofiller size, which may be due to the limited motion space for the polymer chains and monomers in the nanofilled epoxy composite.

Material and methods

Polyester resin was used as matrix, cobalt naphthanate as accelerator and methyl ethyl ketone peroxide (MEKTP) as catalyst. Accelerators and catalysts are mixed with the resin and used to initiate and complete the curing process. Polyester is widely used as a matrix for fiber reinforced composites and as a structural adhesive. Fiber-reinforced Orthothlic polyester resin matrix composites are preferred in load-bearing frame applications, such as aircraft, Automotive, buildings and ships are compared with traditional bulk and similar materials such as wood and metal because of their chemical and mechanical properties and their high strength-to-weight ratio. The hand laying method is used for making composite materials, which is one of the popular processes of free casting process and a simple technique for making composite materials It is a slow, manual and labor-intensive method. Resin and powder materials were mixed Weight ratio is 70:30. The parts are provided with an anti-mold coating to prevent them from sticking to the mold surface. When gel coating is applied, the main surface of the part is coated. Accelerators and catalysts are mixed with the appropriate amount of polyester resin. This scale serves to bind the elements. The prepared powdered material was then mixed with the binding material. Coconut fibers were spread over the mold. The resin and powder mixture was poured into the mold without any gaps. The roller was rotated in the mold cavity. A cover was placed on the mold frame, which spreads the binding material over the entire surface of the frame and applies the load evenly mold. The set of patches was kept in a dry place for 24 hours. The treated product was removed from the mold after 24 hours [11].

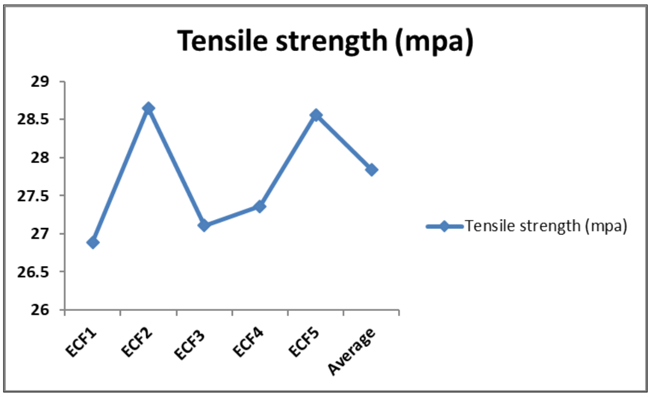
Result and discussion

All five samples produced were tested separately and achieved very good results with different mechanical properties. The observed results of coir are given in Table 1. The sample name are ECF stands for Epoxy coir fibre composite -ECF1, ECF2, ECF3, ECF4, and ECF5.

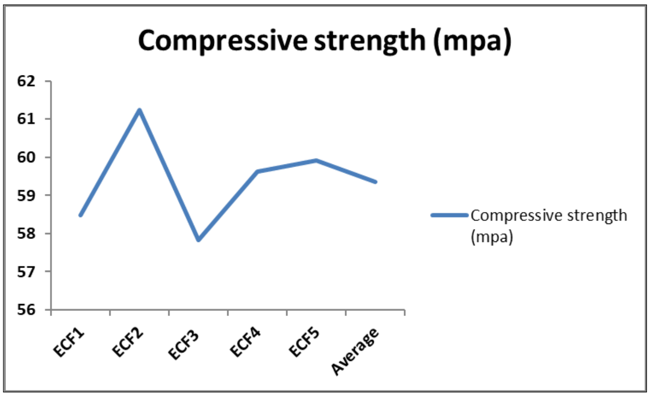
Table 1: Mechanical properties of ECF

Specimen	Tensile strength (mpa)	Compressive strength (mpa)	Flexural strength (mpa)	Impact strength (mpa)
ECF1	26.89	58.48	52.36	70.33
ECF2	28.65	61.25	54.24	68.15
ECF3	27.11	57.83	53.56	68.83
ECF4	27.36	59.62	51.72	65.95
ECF5	28.56	59.92	51.32	64.40
Average	27.842	59.362	52.674	68.122

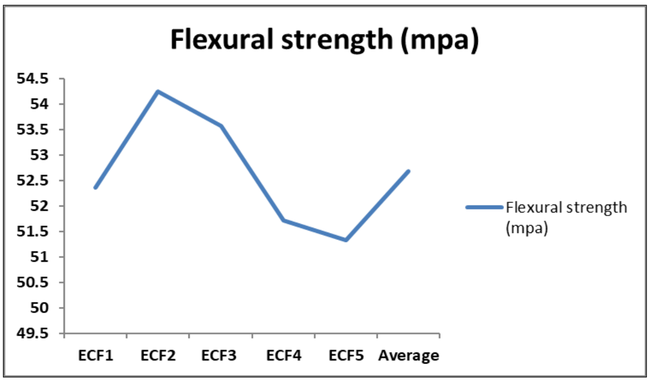
Specimen	Tensile strength (mpa)
ECF1	26.89
ECF2	28.65
ECF3	27.11
ECF4	27.36
ECF5	28.56
Average	27.842



Specimen	Compressive strength (mpa)
ECF1	58.48
ECF2	61.25
ECF3	57.83
ECF4	59.62
ECF5	59.92
Average	59.362

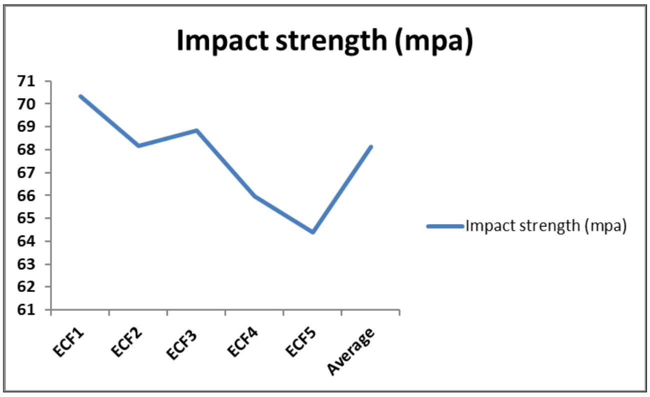


Specimen	Flexural strength (mpa)
ECF1	52.36
ECF2	54.24
ECF3	53.56
ECF4	51.72
ECF5	51.32
Average	52.674



Specimen	Impact strength (mpa)
ECF1	70.33
ECF2	68.15

ECF3	68.83
ECF4	65.95
ECF5	64.4
Average	68.122



1. Tensile Strength and Compressive Strength

The tensile strength of ECF composites was measured and the results are shown in Figure1.The average tensile strength values of ECF composites [12].

2. Flexural Strength and Impact Strength

The flexural strength of ECF composites was measured results are shown in Figure.

Conclusions

The properties of filled, coconut fibre and Al_2O_3 reinforced epoxy composites are significantly influenced by the filler and fibre parameters. As the fiber content increases, the voids in the composites also increase.

The strength properties of the composite increase and then decrease as the fiber content .On the other hand, increasing the fiber content increases the stiffness and tensile modulus of the composites.

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