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Preparation and Testing of Composites using Waste Groundnut Shells and Coir Fibres

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Abstract

Composite materials are now-a-days replacing the traditional materials because of its superior properties such as high tensile strength, low thermal expansion and high strength-to-weight ratio. Natural fibre composites such as groundnut shell polymer composites and coir composites have become more attractive due to their high specific strength, light weight and biodegradability. This work attempts to study particulate natural fiber based epoxy composites. It is concerned with the preparation and testing of composite materials from groundnut shell fibres and coir fibres along with binder and epoxy resins. The groundnut shells are chemically washed, cleaned and then dried in sunlight. The dried shells are then grinded to particle sizes of 1 mm, 1.5 mm, 2 mm and the epoxy resins are added in 70:30 ratio by weight to the fibres in a 12 mm thick mould and different flat square-shaped composites are obtained. Specimens of different particle sizes are cut into standard dimensions as per ASTM for different mechanical and moisture absorption tests. The results thus obtained are relatively compared between groundnut shell and coir fiber composites so as to suggest suitable applications. In general, the coir fibre composites are found to be comparatively better than groundnut fibre composites particularly considering the mechanical properties.

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Keywords: Green composites; bio-fibres; composites; matrix; mechanical testing.

1. Introduction

A composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the

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individual components. Composites, in most cases, are prepared by reinforcing fibres with matrix resins. The reinforcements can be in the form of long or continuous fibres, particulates or whiskers, and the matrix materials usually used are metal, plastics or ceramics. The present work is focused on utilization of waste bio-fiber like groundnut shell and jute fiber for the preparation of composites. Various research groups have worked on ground-nut shell and jute fibres in the past. Morphology of modified surfaces in case of jute fabrics examined using scanning electron microscopy and fourier transformed infrared spectroscopy revealed improved upper surfaces for better adhesion with the matrix [1]. Study of the effect of calcium carbonate on the mechanical properties of groundnut shell powder based composite had been carried out. The experimental investigation on mechanical properties of tensile strength and flexural strength for groundnut shell powder/calcium carbonate/vinyl ester composites showed that the material is greatly influenced by the groundnut shell powder/calcium carbonate composition [2]. Coconut shell reinforced composite was prepared by compacting low density polyethylene matrix with 5%-25% volume fraction coconut shell particles and the effect of the particles on the mechanical properties of the composite produced has been investigated [3]. Another work was carried out to develop a polymer matrix composite (epoxy-resin) using coconut shell powder (CSP) in different particle sizes and reinforcing in different volume and further evaluated its tensile strength, flexural property and hydrophilic behavior along with engineering application of resulting composites [4]. In the work carried out by Berhanu et al. [5], jute fibre-polypropylene reinforced composites were prepared using compression molding process. The investigation stated that the 40 wt% jute fiber reinforced PP composite exhibited the highest tensile strength. However, the tensile strength decreased with further increase in the wt% of jute fiber reinforcement. The cost of production and energy consumption in conventional fibres is more than that of natural fibres. Due to this, natural fibres are preferred over conventional or man-made fibres [6].

The existing research in our considered literature primarily lacks the study regarding potential of these new materials to replace standard materials in use today, and also the cost saving thus achieved. For an agrarian nation like India where groundnut, coconut, jute and bamboo production is large and these products are available in plenty and at very cheap rates, the economic feasibility and potential for such new materials is possibly high and the applications are promising from composites point-of-view. In this work, we intend to explore the potential of natural fibre composites through manufacturing and testing of the same in view as replacement to many commercially used alternatives today.

2. Experimental work

2.1. Mould Preparation

Mould preparation is designing the mould according to the size of the specimen required. Mild steel was selected as the mould material because of its fair hardness, shock absorption capability and easy availability. Four supporting bars of dimensions 163×12×12 mm were used to prepare an enclosure for the mould as shown in Fig. 1. Bolting the supporting bars to the mould facilitates easy removal of the rectangular composite obtained.

Specification of Mould

Sr. no.	Component	Material	Dimensions (mm)	Quantity
1.	Mould base	MS	350×350×12	1
2.	Supporting bars	MS	163×12×12	4

Fig. 1. (a) first picture; (b) second picture.