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Comparative Study on Mechanical Properties of Tamarind Shell and Groundnut Shell Particles Reinforced Epoxy Composite

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Abstract - *Every year large quantity of agriculture wastes like coconut coir, tamarind shell, groundnut shell, peanut shell are disposed due to lack of uses for these materials. Also a step forwarded to use the agricultural waste technically and enhance the properties of several existing material which can be more useful and can have advanced properties than the existing form. This paper explores the potential of tamarind shell particles and groundnut shell particles as a fibre in epoxy composites. The both tamarind shell particles and groundnut shell particles reinforced epoxy composites were prepared by considering the certain volume percentage for both composites i.e. 60% fibre and 40% resin. The mechanical properties such as tensile strength, bending strength and hardness are evaluated for both the composites and compare the same.*

Key Words: Agriculture wastes, tamarind shell, groundnut shell, Epoxy composites

1. INTRODUCTION

Reinforcement in polymer is either synthetic or natural. Synthetic fibres, for example, glass, carbon are used for polymer composites however their fields of applications are restricted because of high cost. Natural fibres have many advantages over synthetic fibres. The potential utilization of different natural fibres for polymer composites has already been explored [1, 6]. Among various natural fibres, tamarind shell and groundnut shell has many advantages. These Fibres have become alternative reinforcement for synthetic fibres in polymer composites, due to their advantages like low density, less to wear during processing, low cost, nontoxic, easy to process, environmental friendly and bio degradability [2].

The tamarind (Tamarindus indica L.) is a long-lived, bushy tree belonging to the Fabaceae family. The possibility of finding use for Tamarind fibres in fibre composite will open a new market for what normally considered waste or used in low value products. [3]. Groundnut shell powder is widely available at very low cost, so it is an ideal filler material in this regard. Groundnut shell powder is made from the most versatile part of the groundnut which is from the shell where this shell is organic in nature. High filler content, however many adversely affect the process ability, ductility and strength of the composites. Groundnut shell powder is the largest oilseed in terms of production [4].

In this study, tamarind shell particle and groundnut shell particle used as a reinforcing agent, with epoxy resin used as a matrix for the preparation of Tamarind and groundnut particulate epoxy composite. In the present investigation, the mechanical properties such as tensile strength, bending strength and hardness are evaluated for both the composites and compare the same.

2. COMPOSITE PREPARATION

The tamarind and groundnut shell is gathered from local sources like farmers in rural areas. Tamarind shell and groundnut shell is washed repeatedly with water to remove dust and soluble impurities. The contents are sun dried followed by oven drying at 75^0 C. The dried tamarind shell and groundnut shell is converted into powder using a hammer mill and sieved to obtain powder with average size of 100µ [5]. Fig 1. And Fig.2 shows tamarind and groundnut shell particles. Fig. 3 shows the mould made of mild steel of dimension of 200×200×5 mm^3 is utilized for fabrication of composite. The tamarind and groundnut shell particles are blended separately with epoxy resin [L-12] and hardener [K-6] by the basic mechanical mixing to prepare the separate composites and placed in the mould uniformly. The designation and detail composition of composites are presented in Table 1.

Fig-1: Particles of Tamarind Shell

The mixture of each composite is safeguarded under a load of around 20 bar pressure which is maintained at room temperature for 24 hours under a compression moulding press machine. Specifications of Compression Moulding Press Machine are presented in Table 2. Later, the mould is taken out and remove the composite plate from the mould. Fig.4 and Fig. 5 shows tamarind shell particulate composite and ground nut shell particulate composite respectively.

Fig-2: Particles of Groundnut shell

Fig-3: Mould box with cover plate

Table-1: Designation of Composites

Particles	Compositions
Tamarind	Epoxy (40wt. %) + Tamarind shell particles (60wt. %)
Groundnut	Epoxy (40wt. %) + Groundnut shell particles (60wt. %)

Table-2: Compression Moulding Press Machine Specifications

Particulars	Specifications
Power supply	415 V
Power load	10 KW
Maximum pressure	100 bar
Working pressure	100 bar
Weight	1500 Kg

3. MECHANICAL TESTING

After fabrication the test specimens were subjected to various mechanical tests as per ASTM standards [1]

3.1 Tensile test

The tensile test specimen prepared as per the ASTM A370 standard is placed in the Universal Testing Machine Instron 1195, a constant state of loading is applied on the either side of the specimens which are equal and opposite direction. Tensile test specimen for tamarind shell composite and groundnut shell composite is shown in Fig. 6 and Fig. 7.

Fig-4: Tamarind shell particulate composite

Fig-5: Ground nut shell particulate composite

Fig-6: Tensile test specimen of Tamarind shell composite

Fig-7: Tensile test specimen of Groundnut shell composite

3.2 Three Point Bending test

The bending test specimen prepared as per the ASTM A370. The specimen is loaded at the center of the span through a loading cell. The test is carried until the specimen completely fails. The bending test specimen of Tamarind shell composite and groundnut shell composite is shown in Fig.8 and Fig.9.

Fig-8: Bending test specimen of tamarind shell composite

3.3 Hardness testing:

The hardness specimen prepared as per the ASTM D785. The hardness test is carried out using a Rockwell tester. The Hardness test specimen of tamarind shell composite and groundnut shell composite is shown in Fig.10 and Fig.11.

Fig-9: Bending test specimen of Groundnut shell composite

Fig-10: Hardness test specimen of Tamarind shell composite

Fig-11: Hardness test specimen of Groundnut shell composite

4. RESULTS AND DISCUSSION

4.1 Tensile test

The tensile strength of composites is shown in the Fig.12, represents the comparative plot of tensile test on composite of both tamarind and groundnut shell and it is found that the tamarind shell composite has maximum tensile strength of 12.36 N/mm^2 than the groundnut shell composite of 10.86 N/mm^2.

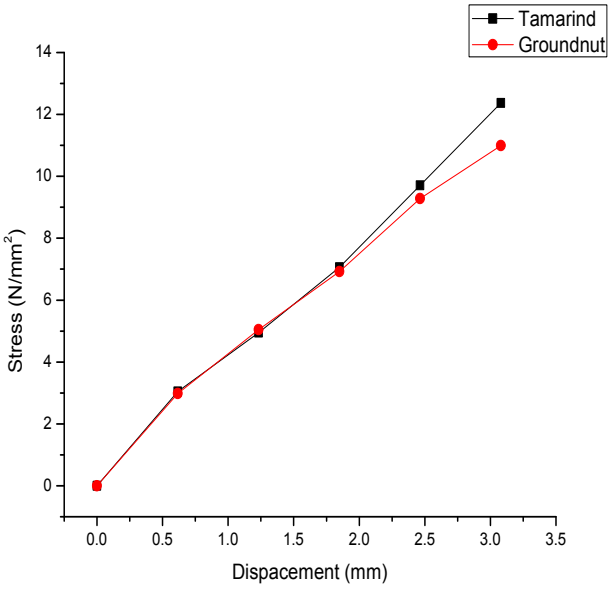

Fig-12: Variations in stresses of tamarind and groundnut shell composite with displacement

4.2 Bending Test

The bending strength of composites is shown in the Fig.13, represents the comparative plot of bending test on composite of both tamarind and groundnut shell and it is found that the tamarind shell composite has maximum bending load carrying capacity of 176.5 N than the groundnut shell composite of 98.1N.

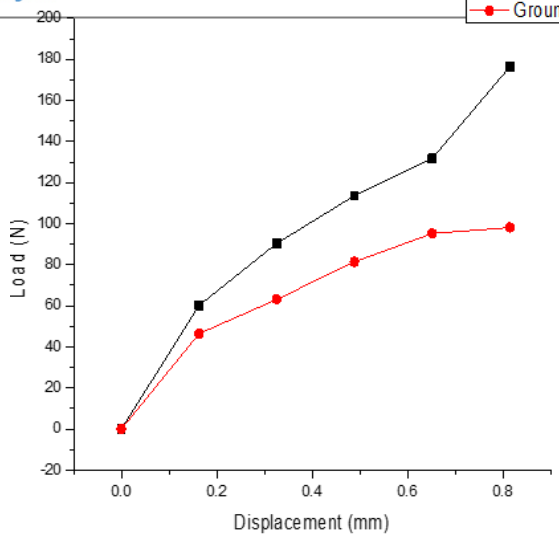

Fig-13: Variations in loads of tamarind and groundnut shell composite with displacement

From table 3, it is seen that the tamarind shell composite has maximum hardness of 78 HRM than the groundnut shell composite of 74 HRM.

Table 4 shows comparative mechanical properties of tamarind shell and groundnut shell particulate composite.

Table-4: Mechanical properties of Composites

Composite	Tensile Strength (N/mm^2)	Peak bending Load(N)	HRM
Tamarind	12.36	176.5	78
Groundnut	10.86	98.1	74

5. CONCLUSIONS

The variation of tensile, bending and harness properties of the tamarind shell particulate composite and groundnut shell particulate composites were studied. From experimental results, it is found that, compared with groundnut shell particulate composite, the tamarind shell particulate composite provides better mechanical properties. This behaviour is because of tamarind shell particulates are relatively harder and more brittle than the groundnut shell particulates.

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BIOGRAPHY

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