Experimental Evaluation of Mechanical Properties of Natural Fibre Reinforced with Tea Powder as a Filler Material

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***Abstract*: Fibre reinforced polymer composites have played a dominant role for a long time in a variety of applications for their high specific strength modulus. The fibre, which serves as a reinforcement in reinforced plastics, may be synthetic or natural. An attempt has been made to utilize the coir, as a natural fibre abundantly available in India. Natural fibers are not only strong and light weight but also relatively cheap. The present work describes the difference between development and characterization of a new set of natural fibre based polymer composite consisting of treated and untreated coir as a reinforcement, tea powder as filler, epoxy resins. coir composites were developed and their mechanical properties were evaluated at different volume fraction and test were carried out and the results were presented. Experimental results and the result were presented.**

***Keywords:* Composite materials, Natural fibre, Mechanical properties, Filler material.**

I. INTRODUCTION

The composite materials have been used from centuries ago, and it all started with natural fibers. Natural fibers have become important item in the economy and in the fact they have turned out to be a significant source of job for developing countries. Today these fibers are assessed as environmentally correct materials owing to their biodegradability and renewable characteristics. For example, natural fibres like sisal, jute, coir, oil palm fibre have been proved reinforcement in thermoset and thermoplastic matrices.

Composites are materials that comprise strong load carrying material imbedded in weaker material. Reinforcement provides strength and rigidity helping to support structural loads. The matrix or binder maintains the position of orientation of the reinforcement. Significantly constituent of the composite retain their individual physical and chemical properties, yet together produce combination of qualities with individual constituent should be incapable of producing alone reduced weight and increased performance properties have paved a path to development of advanced engineering materials. Composites products have good mechanical properties to weight ratio and the technological permit the manufacture of complex and large shapes. Fillers are added to polymer matrix to reduce cost, since most of the filler materials are much less expensive, increase modulus, reduce mould shrinkage and produces smooth surface. The application of natural composites is being targeted in various fields due to the environmental and economic benefits which could be used in automotive industry as interior parts and in construction sector such as walls and roofs.

Now a day's many individual companies are looking for new composite material, which has good specific properties like mechanical, chemical characteristics. In searching for new material, a study has been made where coconut fibre is compounded with composite material. Coir is a natural fibre of the coconut husk. It is a thick and coarse but durable fibre. It is relatively waterproof and has resistant to damage by salt water and microbial degradation.

A. Natural fibre reinforced composite

Fibre reinforced polymer composite have played a dominant role for a long time in a variety of application for their high specific strength and modulus. The manufacture use and removal of traditional fibre reinforce plastic, usually made of glass, carbon or aramid fibre . By natural fibre composites we mean a composite material that is reinforced with fibres, particle or platelets from natural resources. Natural fibre includes those made from plant, animal and mineral sources. Natural fibres can be classified according to their origin. Detailed classification is shown in figure1. In a study carried out by C. Chaithanyan et.al [1], The composites with 50% Sisal-Glass fibre and 50% resin combination has maximum tensile strength of 97.71 Mpa. The breaking load of Sisal-Glass fibre reinforced composite found high, such that 1.10 times higher than Sisal-Coir-Glass fibre reinforced composite and 1.33 times higher than Coir-Glass fibre reinforced composite.

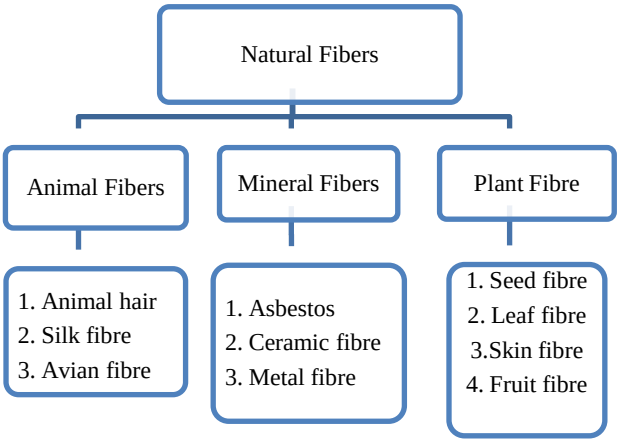

Fig. 1 Classification of natural fibers

According to N Anupama et.al [2], The composition of coconut fibre and polyester resin for the development of composite material are treated the coir with alkaline solution to remove the same amount of lignin which effects strength of the material. Hand layup technique is used for preparation of the specimen. Specimens subjected to testing under ASTM standards. Here concluded that the strength of composite material is increases with increasing the percentage of resin. In addition the strength of the specimen depends on curing time. In study carried out by K. Kannapiran et.al [3], strength of the composite material increase with the coir length and polyster resin give more strength than epoxy. A study by M.Sakthivel et.al [4], on natural fibre composite and investigated potential natural fibre for the development of new sustainable material.

II. MATERIALS AND METHOD

A. Specimen preparation

The method is used in the present work for manufacturing of specimen is hand layup technique where Coir is used as a fibre to make a specimen, Epoxy (L-12) is used as a matrix material and room temperature curing polyamine hardener (K-6).

B. Experimental setup

Following tests were conducted in the present work;

- Tensile Test
- Compression Test
- Flexural Test
- Hardness Test

The tests were conducted on calibrated Universal Testing Machine. Different tests were conducted such as hardness test on type 'D' Durometer which has hardened steel rod 1.1mm-1.4mm diameter with 30^{o} conical point, 0.1 radius tip.

III. RESULT AND DESCUSSION

A. Tensile Test

The load displacement of the tested specimen is given in below.

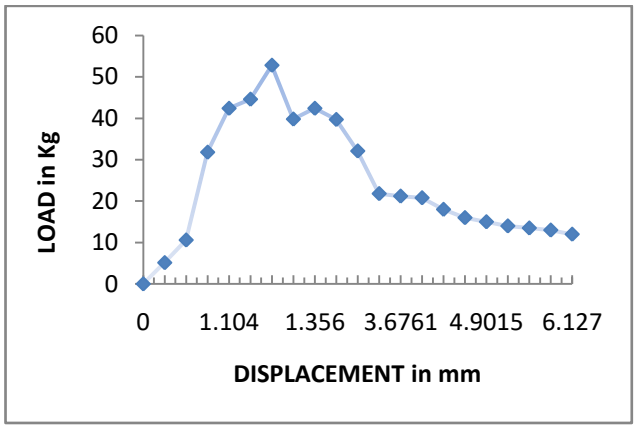

Fig. 2 Tensile test of normal sample

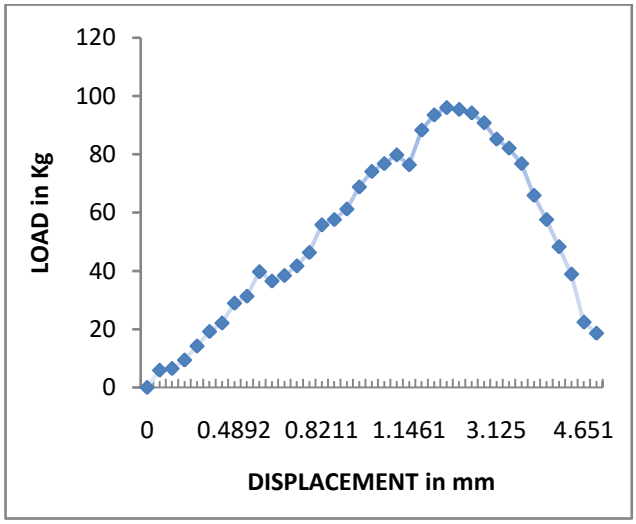

Fig. 3 Tensile test of Untreated with 10% of tea powder

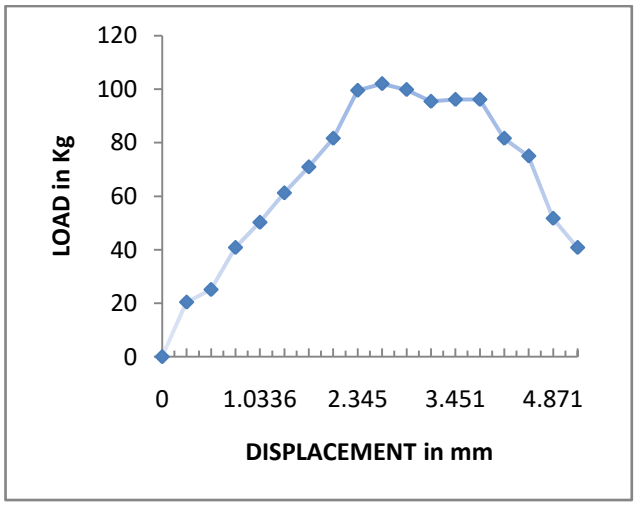

Fig. 4 Tensile test of Treated with 10% of tea powder

B. Compression Test

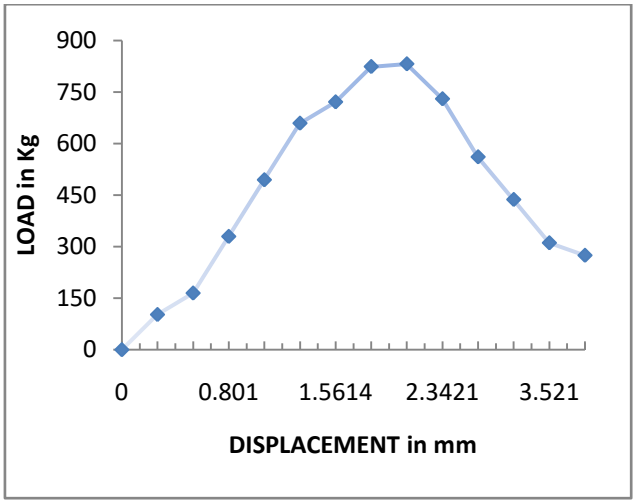

Fig. 5 Compression test of normal sample

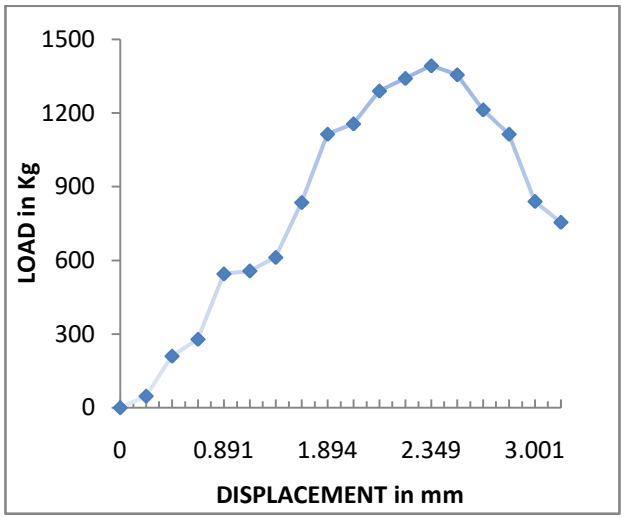

Fig. 6 Compression test of Untreated with 10% of tea powder

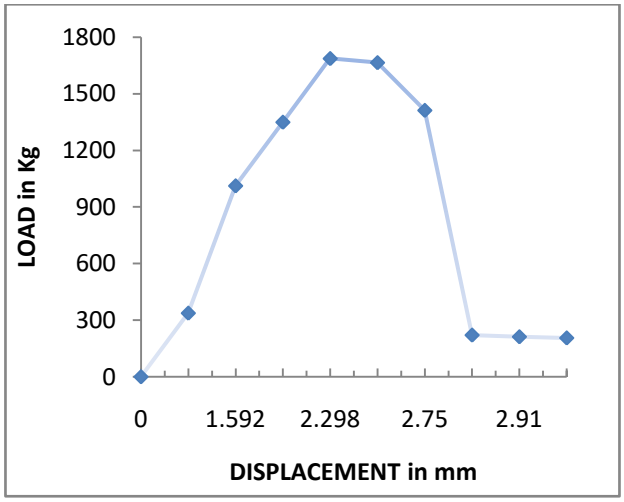

Fig. 7 Compression test of Treated with 10% of tea powder

C. Flexural Test

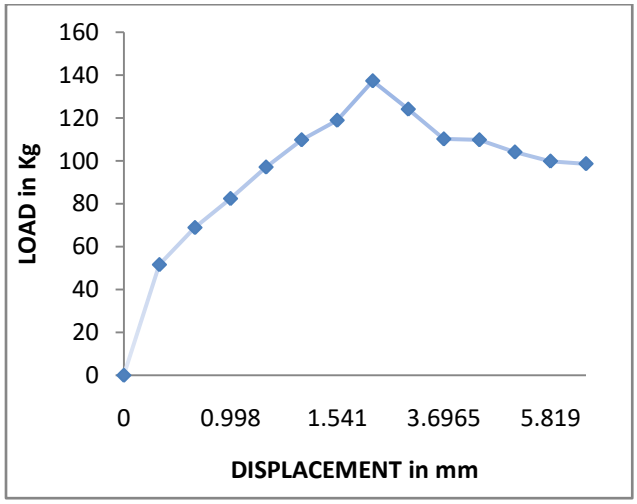

Fig. 8 Flexural test of normal sample

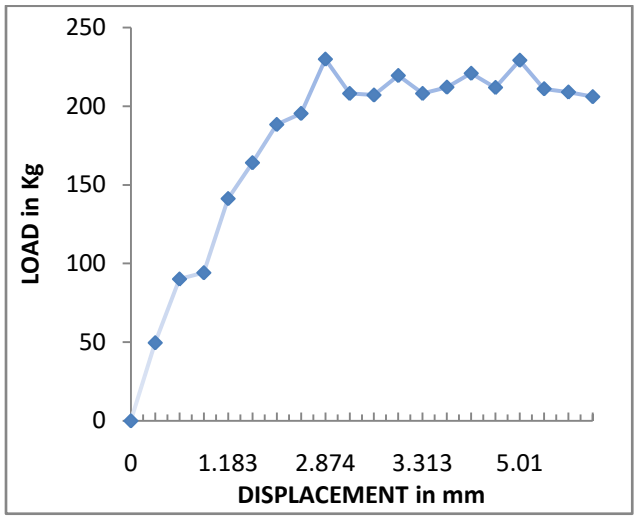

Fig. 9 Flexural test of Untreated with 10% of tea powder

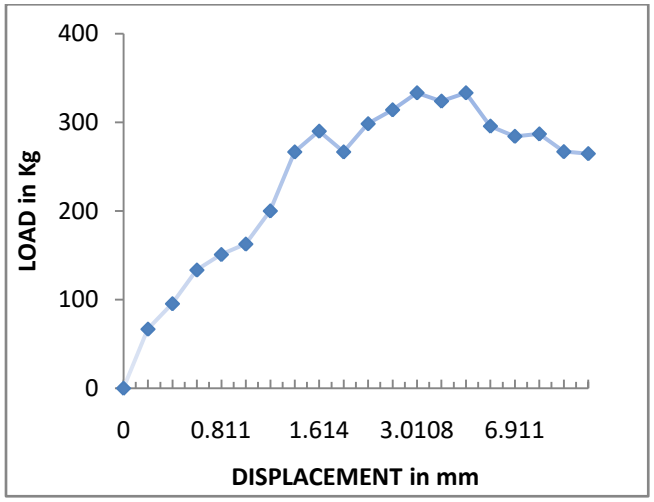

Fig. 10 Flexural test of Treated with 10% of tea powder

C. Hardness Test

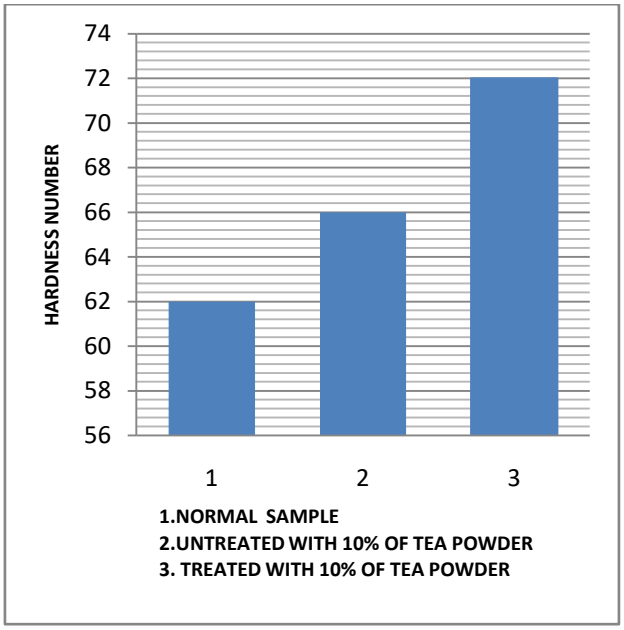

Fig. 11 Hardness test

IV. CONCLUSION

The research was carried out to find the mechanical behaviour of randomly oriented coir fibre mixed with reinforced epoxy composites and tea powder. In general the composite having mass of 10% tea powder showed notable result when compared to the normal fibre sample loading composites due to the effect of material stiffness. Natural frequency of composites was found to be proportional to the tensile strength. The chemically treated fibres have more tensile strength when compared to untreated coconut coir fibres. When the fibres tested in water at different period of time there is a slight change in their tensile properties. The differences are very less due to this reason we can use in different marine application.

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