



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: VI Month of publication: June 2019

DOI: <http://doi.org/10.22214/ijraset.2019.6241>

www.ijraset.com

Call:  08813907089

E-mail ID: ijraset@gmail.com

Evaluation of Static Mechanical Properties of Coated Sisal fiber Reinforced Polyester Composite

Ravi Chaudhary¹, Vivek Patel², Adarsh Patel³

Abstract: *The need to running an environmentally safer future has encourage the researchers to look over the artificial or synthetic fibres based composites and putting more thought into the utilization of natural fibres based polymer composites. Natural fibres however more than compensate for their poor compatibility with the matrix, inherent high moisture absorption rate with their positive attributes like low cost, low density, non-abrasively, good thermal properties, enhanced energy recovery and bio degradability. To remove water absorption and increase mechanical properties of composite some treatment has been done. In present work, a novel treatment of PLA (Polylactic acid) and ABS (Acrylonitrile butadiene styrene) coating on sisal fibres and its influence on the water absorption, static mechanical properties of its composites has been determined. The treated sisal fibres were used consisted in alkali treatment, PLA coating and ABS coating to fabricated its polyester based composites by hand lay-up technique keeping constant fibres content as 20 wt.% . Water absorption analysis was carried out in terms of water uptake (%).*

I. INTRODUCTION

Engineering materials constitute the foundation of technology, whether the technology is applied to structural, thermal, electronic, electrochemical, biomedical, environmental or other applications. The history of human civilization is evolved from the Stone Age to the Bronze Age, the Iron Age, and the Steel Age and to the Space Age [1]. Each age is marked by the advent of certain materials. The Iron Age brought tools and utensils, the Steel Age brought rails and industrial revolution, and the Space Age brought the even more advanced materials i.e. composite materials.

The development of composite materials and their related design and manufacturing technologies is one of the most important advances in the history of materials. The use of fiber reinforced composite materials as an alternative to traditional metal materials is becoming widespread [2]. The main technological advantages of these materials are low weight, high specific strength and stiffness, environmental resistance and long life.

Compared to metals, composite parts can be easily made with a relatively low tooling cost. Polymer matrix reinforced by woven fabrics is probably the most commonly used form of composites in structural application such as aircrafts, boats, automobiles, etc. The aircraft industry is an interesting application area for new types of rapidly manufactured composites because they use prolonged high temperature curing processes for fabrication of composite parts, which is justified if high performance materials or high exploitation temperatures are required. However, a number of aircraft parts are subjected to moderate temperatures and moderate stresses. Such parts can be produced at significantly lower costs using alternative processes and materials [3, 4].

A. Composite

A composite material is defined as a material system which consists of a mixture or a combination of two or more distinctly differing materials which are insoluble in each other and differ in form or chemical composition. Thus composites are combination of two materials in which one of the materials called reinforcing phase is in the form of fiber sheets or particles and are embedded in other materials called the matrix phase.

B. Matrix

Many materials when they are in a fibrous form exhibit very good strength property but to achieve these properties the fibres should be bonded by a suitable matrix. The matrix isolates the fibres from one another in order to prevent abrasion and formation of new surface flaws and acts as a bridge to hold the fibres in place.

C. Reinforcement

The role of the reinforcement in a composite material is fundamentally one of increasing the mechanical properties of the neat resin system. All of the different fibers used in composites have different properties and so affect the properties of the composite in different ways.

II. RESULT AND DISCUSSION

A. Tensile Test

Tensile strength and tensile modulus of untreated and treated sisal composites are given in Table 3.1. It was observed that both treated sisal composites have higher values of tensile strength and tensile modulus than untreated sisal composites.

Table 3.1 Result of Tensile Strength and Tensile Modulus

Composite	Tensile strength (MPa)	Tensile modulus (GPa)	Elongation (%)
SC	24.71±1.67	1.42±0.08	4.53±0.32
SC (NaOH)	34.57±2.01	2.11±0.07	3.75±0.24
SC(PLA)	36.78± 2.21	2.32±0.15	2.56±0.16
SC(ABS)	39.66±2.24	2.39±0.15	2.40±0.11

B. Flexural Test

Table 3.2 shows the flexural strength and flexural modulus of untreated and treated sisal composites. It was observed that both treated sisal composites have the higher values of flexural strength and flexural modulus than untreated sisal composites which show a positive effect of treatments.

Table 3.2 Result of Flexural Strength and flexural Modulus

Composite	Flexural strength (MPa)	Flexural modulus (GPa)	Elongation (%)
SC	55.12±3.31	2.24±0.17	2.13±0.17
SC (NaOH)	72.70±4.45	3.52±0.20	2.57±0.19
SC(PLA)	81.33±5.45	3.67±0.22	2.25±0.13
SC(ABS)	84.40±5.61	3.85±0.22	2.14±0.14

C. Impact Test

Table 3.3 shows the impact strength of untreated and treated sisal composites. Similar trend like tensile and flexural test was found for impact test also. In case of impact test, it was also observed that both treated sisal composites have the higher values of impact strength than untreated sisal composites. The reason may be due to enhancement in stiffness of fibres and adhesion between fibres and matrix by PLA coating that increases the capability of sisal composites to absorb more energy as well as to resist crack transmission

Table 3.3 Result of Impact Strength and Impact energy

Composite	Impact strength (kJ/mm ²)
SC	20.22±1.47
SC (NaOH)	23.55±1.98
SC(PLA)	25.75±2.01
SC(ABS)	28.50±2.05

D. Water Absorption Behavior

In case of natural fiber reinforced polymer composites, water absorption behavior depends upon diffusion of water molecules into micro gaps of polymer chain and interface between fibres and matrix. It was observed that both treatments (alkali and coating) were effective in decreasing the water absorption when compared with SC. The maximum value of water absorption at saturation stage was found for SC followed by SC(NaOH), SC(PLA) and SC(ABS).

Table 3.4 results obtained from water absorption test

Composites	Percentages of water uptake at infinite time
SC	5.66
SC(NaOH)	4.74
SC(ABS)	2.11
SC(PLA)	3.8

III. CONCLUSION

In this section, effect of coating of ABS, PLA and treatment on sisal fiber for mechanical properties and water absorption were studied. Based on results and discussion of the coated sisal fiber composite the following conclusions are drawn.

- Tensile strength gives best result in SC(ABS) in the four different specimens. Each type of composite has five specimens and the average results of all five specimens are taken. Tensile strength of SC(ABS), SC(PLA), SC (NaOH) increased by 60.51%, 48.84%, 40% from sisal polyester composite and Tensile modulus of SC(ABS), SC(PLA), SC (NaOH) increased by 68.31%, 63.38%, 48.59% from sisal polyester composite. And tensile strength and modulus follow the order is SC(ABS)>SC(PLA)>SC (NaOH)>SC
- Flexural strength gives best result in SC(ABS) in the four different specimens. Each type of composite has five specimens and the average results of all five specimens are taken. Flexural strength of SC(ABS), SC(PLA), SC(NaOH) increased by 53.12%, 47.55%, 31.89% from sisal polyester composite and Flexural modulus of SC(ABS), SC(PLA), SC (NaOH) increased by 71.87%, 63.88%, 57.14% from sisal polyester composite. And flexural strength and modulus follows the order is SC(ABS)>SC(PLA)>SC (NaOH)>SC
- Impact strength gives best result in SC(ABS) in different treatments. Each type of composite has five specimens and the average results of all five specimens are taken. The impact strength of SC(NaOH) was observed 23.55 kJ/mm² which is 16% higher than SC. The composite SC(ABS) has the highest value of impact strength (25.75 kJ/mm²) which is more than 9% and 27% than those of SC(NaOH) and SC composites. And impact strength follows the order is SC(ABS)>SC(PLA) >SC(NaOH)>SC
- Tendency of moisture absorption in humid air or in water was found by sisal fiber reinforced polymer composite due to hydrophilic nature of fiber. The effect of moisture absorption causes the degradation of fiber-matrix interface region as resulting in a reduction of mechanical properties along with change in dimension of composite. The Sisal fiber reinforced polymer composite shows the higher water absorption and SC(ABS) is shows minimum water absorption and the order is SC(ABS)>SC(PLA)>SC (NaOH)>SC.

REFERENCES

- Chung D, Composite Materials: Functional Materials for Modern Technologies, Springer Science & Business Media, 2013.
- Agarwal, Broutman L. Analysis and Performance of Fiber Composites, John Wiley & Sons, Inc., 2006.
- Zweben C. Mechanical Engineers' Handbook: Materials and Mechanical Design, John Wiley & Sons 2006.
- Saheb DN, Jog JP. A Review, Advances in Polymer Technology. Natural Fiber Polymer Composites 1999; 18: 351-363.
- Acharya SK et al. NIT Rourkela- Weathering behavior of bagasse fiber reinforced polymer composite 2015.
- Mohanty AK, Khan MA, Hinrichsen G. Surface modification of jute and its influence on performance of biodegradable jute-fabric/Biopol composites. Compos Sci Technol 2000; 70: 1115-1124.
- Usamani M, Arthur, Salyer O, Ival, Ball L, Schwendeman L. Bagasse-Fiber-Reinforced Composites." Journal of Elastomers and Plastics 1981; 13: 46-73.
- Ranjan Chitta. Preparation and Characterization of Polymer Matrix Composite using Natural Fiber Lantana-Camara. Department of Mechanical Engineering NIT Rourkela, India, June 2010.
- Biswas S. Processing, Characterization and Wear Response Of Particulate Filled Epoxy Based Hybrid Composites. PhD diss, 2010.
- Ho MP, Wang H. and Lee JH, Ho CK, Lau KT, Leng JS and Hui D. Critical Factors on Manufacturing Processes of Natural Fibre Composites. Composites: 2012; 43: 3549-3562.



10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24*7 Support on Whatsapp)