



EFFECT OF TRI-BIOLOGICAL PROPERTIES ON JUTE/E-GLASS FIBRE REINFORCED POLYMER COMPOSITES

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ABSTRACT

Composite materials, combination of two or more different constituents with different properties, find extensive use in transport and space vehicles due to their high specific strength. This paper explains about the effects of tri-biological properties on jute fibre reinforced by E-glass fibre. In this deterioration test is conducted on sunlight. Fatigue test is done to find the cracks. Wear tests are done at different angles in order to find out the highest wear out. They are subjected to tensile and hardness test and surface morphology is carried out for the specimens.

Keywords: Tri-biological properties, deterioration, wear tests, fatigue test, cantilever beam.

1. INTRODUCTION

More than two decades, fiber-reinforced polymer composites have acknowledged tribo-engineering materials, which are consistently used in mechanical components such as bearings, bushes, bearing cages, gears, cams, gears, brakes, clutches, seals bearings, transmission belts, tank track pads, rollers, office automation machinery and artificial joints etc. where wear performance in non-lubricated condition is a basic parameter for the material selection. With consumer demand, new materials have enforced to replace conventional non-renewable materials in manufacturing industries such as automotive, construction, and packaging. These days increasing the interest of natural fiber polymer composites are being chosen over the synthetic based fiber composites due to the several advantages such as easy availability, low density, low cost, biodegradability, a range of mechanical properties and less abrasiveness. Composite material of jute fibre reinforced by E-glass fibre is subjected to deterioration under sunlight and subject to air also. This process is subjected to effect of mechanical and hardness properties of the material. A cantilever bending machine for thin sheet specimens was developed to clarify the bending orientation dependence on fatigue fracture behaviour in the composite material. The Bending stiffness - The bending moment per unit width of a rectangular test piece, divided by the curvature according to the expression:

$S_b = M/c$ where S_b is the bending stiffness; M is the bending moment; c is the curvature (the inverted value of the radius of curvature); d is the width of the test piece. Abrasive wear may be defined as where hard asperities on one surface move across a softer surface under load penetrate and removes material from the softer surface, leaving grooves. The rate of abrasion depends on the surface characteristics, the flow rate of abrasives, nature of abrasives and other environmental factors. The abrasive wear is controlled by many factors such as operating conditions, design parameters, the abrasion characteristics and material properties. The wear data of the composites reveal that the wear behaviour strongly depends on the operating parameters. For abrasion of

polymeric composites, there have been many attempts to understand the tribo-behavior of various materials in various operating parameters and efforts. Exhaustive literature review on three body abrasion behaviour of polymer composites that parameters namely fiber loading, sliding distance, normal load and abrasive size etc. effects the wear behaviour of polymer composites

2. MATERIALS

The material is Jute fibre reinforced by E-glass fibre composite. The materials are purchased from Ram composites Pvt. Ltd, Hyderabad. Jute/E-glass composites were prepared in square shape samples of size 25mmx25mmx3mm by the conventional hand layup process.

3. EXPERIMENTAL

The investigations were carried out with Jute/E-glass composites. The composites used for the present investigations were prepared by the conventional hand layup process of various shapes. % deterioration of material due to sun light, cantilever bending and wear testing are conducted. Specimens were then removed from the chamber and tested for their mechanical properties. After that the specimens were subjected to micro structural characterizations.

3.1 % deterioration of material due to sun light: The specimens were subjected under sunlight for 240hrs, 275 hrs, 288 hrs, 300hrs and 336hrs respectively and tensile tests are conducted

3.2 Cantilever bending: The samples were subjected to fatigue analysis under cantilever bending and initiation cracks were studied. A photograph of cantilever bending is shown in Figure-1.

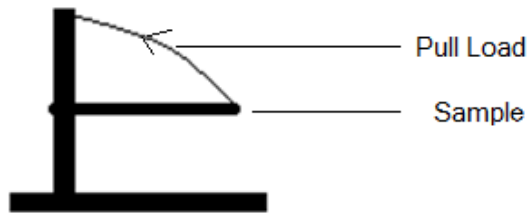


Figure-1. Cantilever bending.

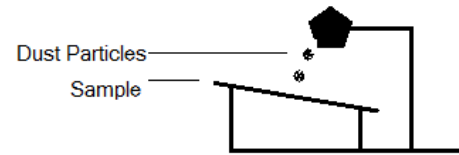


Figure-2. Wear loss.

3.3 Wear Testing: The samples were placed at an angle of 15° and particles of 75μ at a rate of 10gms/min with various angles of 30° , 45° , 60° , 75° and 90° are studied and they were subjected to tensile and hardness tests. Photographs are shown in Figure-2.

3.4 Surface morphology: The retrogression in mechanical properties related to different conditions had been characterized using scanning electron microscopy (SEM).

4. RESULTS AND DISCUSSIONS

4.1% deterioration of material due to sunlight: When samples are subjected to this test changes were observed in its colour, weight and tensile strengths.

Table-1. Shows the specimens weight and tensile strength changes as a function of the retrogression period for the different exposure environments.

S. No.	No. of hours subjected to sunlight	Initial weight (Gms)	Final weight (Gms)	Initial tensile strength (MPa)	Ultimate tensile strength (MPa)
1	240	5.563	5.5625	84	81
2	275	5.563	5.562	84	79.4
3	288	5.563	5.5618	84	78.2
4	300	5.563	5.5612	84	77.1
5	336	5.563	5.561	84	76.8
6	360	5.563	5.561	84	76.8
7	375	5.563	5.561	84	76.8
8	400	5.563	5.561	84	76.8

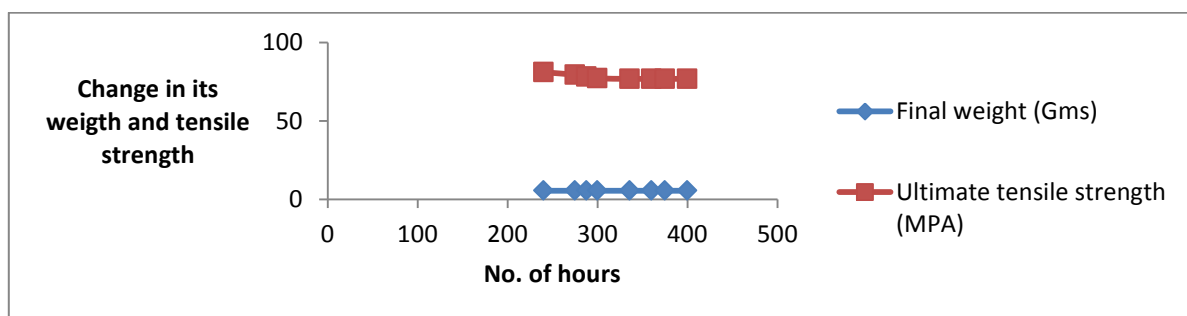


Figure-3. Graph showing change in Tensile strength and its weight with respect to No. of hours.

4.2 Cantilever bending: Three samples were tested under it and maximum diameters of cracks are observed.

S. No.	Dia of first sample (μ m)	Dia of second sample (μ m)	Dia of third sample (μ m)
1	42.82	40.39	41.98



4.3 Wear testing: When samples were subjected at an angle of 15° and particles of 75μ at a rate of 10gms/min with various angles of 30° , 45° , 60° , 75° and

90° for 60 minutes, changes were observed in their weight, surface deterioration, tensile strength and hardness.

S. No.	Angles	Minutes	Initial tensile strength	Ultimate tensile strength	Hardness
1	30	60	84	84	53
2	45	60	84	84	53
3	60	60	84	84	53
4	75	60	84	83.5	53
5	90	60	84	82.4	53

When it is subjected to 180 minutes, hardness decreased to 51.8 and ultimate tensile strength reduced to 81Mpa.

4.4 Surface morphology

The following microphotograph shows the effect of tri-biological properties in jute/E-glass fiber composites. As discussed earlier the specimen subjected to % deterioration of material due to sun light before and after exposure of sunlight are shown in Figures 4 and 5, maximum diameter is shown in fig6 and wear loss is shown in Figure-7.

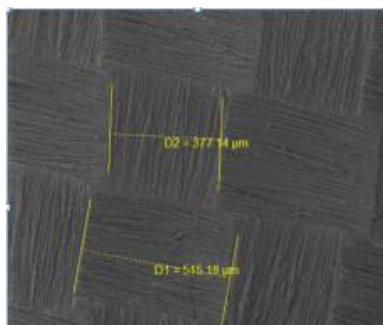


Figure-4. Before sunlight.

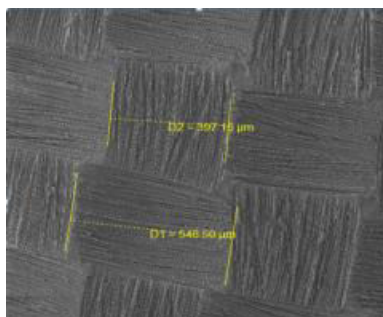


Figure-5. After sunlight.

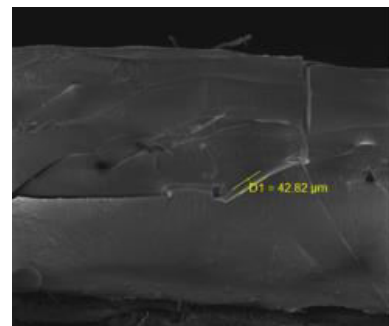


Figure-6. Max wear diameter.

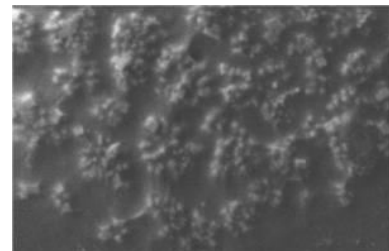


Figure-7. Wear loss.

5. CONCLUSIONS

When effect of tri-biological properties are studied on jute/E-glass fibre, the following conclusions may be drawn for this study:

Tensile strength reduces with increase in number of hours upto 336 and remain constant after that. Maximum crack diameter observed is 42.82μ

Wear loss is very minimum and it is observed at 75° for 180 minutes.

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