

# INVESTIGATION ON MECHANICAL PROPERTIES OF HYBRID FIBER REINFORCED COMPOSITES

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**Abstract**—In modern technology, the composites materials play a major role to meet various requirements in all the manufacturing industrials needs. Such as, it increases physical properties, chemical and structural properties. Hybrid fiber can be defined as the two or more fibers mixed together. In our study, the Akund and Palmyra fibers are mixed together. So these fibers may be called as hybrid fibers. The mixing composition of first matrix is 75%(A) and 25%(P) and mixing composition of second matrix is 25%(A) and 75%(P). In addition as a resin, we use Epoxy (LY556) which is the suitable hardener for this type hybrid fiber. It is proposed to investigate the mechanical properties of fiber such as tensile test, impact test, flexural test and SEM (Scanning Electron Microscope) and its result were compared. **Keywords**—Composites, Akund fiber, Palmyra fiber, Epoxy Resin

## I. INTRODUCTION

Composite materials are the combination of two or more distinct materials with intensifies properties. The main objectives of using the composite materials are to gain high strength to weight ratio and to meet the applications with precise properties. Composite materials are made up of fibers, resin and some additives. The visibility of this project is to develop composites with reduced mechanical stresses to avoid failure and creating environmental friendly in atmosphere. Many of the polymer composites have glass fiber such as reinforcement even the polymers in usage process polluted the environment. The glass fiber and fabrics are non-degradable property. Currently the use of natural cellulosic fibers, e.g.: flax, sisal, banana, jute, coir, hemp, is being considered, as an effective alternative to traditional fibers such as glass, carbon and aramid in polymer composite. The increasing interest in this material is due to the inherent environment friendly nature of the natural fibers, leading to carbon dioxide pacification, their low cost and low density. Other advantages include biodegradability, recyclability

and significant processing etc. In particular, equipment abrasion, energy consumption, and respiratory irritation are all reduced. Epoxy Resin is

widely used in industrial applications, such as adhesive, coatings, and aerospace structure. Due to its excellent mechanical and chemical properties, epoxy is also one of the important materials used as the matrices for FRP. It has low shrinkage upon curing and good resistance. Natural fibers are used in industries like textile, building, plastic and automobile industries. Natural fibers have higher insulation properties. Since natural fiber has low weight and high strength and stiffness. It is used in wide large of application in industries.

## II. MATERIALS

AND

### METHODOLOGY A. Raw Material

#### A.1 Akund Fiber

Akund is a naturally occurring composite material from stems of *calotropis procera* which grows abundantly in Most of the tropical countries. The use of renewable biomass as a Raw material in composites production was one approach. The use of renewable biomass may result in several benefits such as environmental and socioeconomic .The use of renewable biomass may result in several benefits such as environment friendly. It is considered a composite material because it consists of Cellulose fibers embedded in a lignin matrix. Cellulose fibers are aligned along the length of the akund providing maximum tensile flexural strength and rigidity in that direction. Over 1200 akund species have been identified globally. Akund has a very long history with human kind. Akund Chips were used to record history in ancient China. It has been used widely for Household products and extended to industrial applications due to advances in processing Technology and increased market demand. In Asian countries, Akund has been used for Household utilities such as containers, chopsticks, woven mats, fishing poles, cricket Boxes, handicrafts, chairs, etc. It has also been widely used inbuilding applications, such As flooring, ceiling, walls, windows, doors, fences, housing roofs, trusses, rafters and Purloins; it is also used in construction as structural materials for bridges, water transportation Facilities and skyscraper scaffoldings.

## A.2 Palmyra Fiber

Palmyra or Asian Palmyra palm (Palmyra flabellifer) is an economically useful and widely cultivated tree, native to South and Southeast Asia. commonly known as doub palm, palmyra palm, tala palm, toddy palm or wine palm, is native to the Indian subcontinent and Southeast Asia, including Nepal, India, Bangladesh, Sri Lanka, Cambodia, Laos, Burma, Thailand, Vietnam, Malaysia, Indonesia and the Philippines. It is reportedly naturalized in Pakistan, Socotra, and parts of China Palmyra is a long life tree and can live up to 100 years reaching a height of 30 m, with a canopy of leaves and a large trunk resembling that of a coconut tree . The conventional way this fruit is eaten is when the outer casing is still unripe while the seeds are eaten as the fruit. But if the entire fruit is left to ripen, the fibrous outer layer of the palm fruits can also be eaten Raw, boiled, or roasted. When this happens, the fruit takes a purple-blackish hue and tastes similar to a Mango. The skin is also eaten as part of the fruit similar to how mango skins are often consumed along with the fruit. The outer layer of the palm is separated from the ripened palmyra fruit and used as a fiber.

## B. METHODOLOGY

### B.1 Mould preparation

The fiber and resin were mixed in 1:4 ratios. Then the mixture was poured in the die. The ASTM standard size of the die is 180mm length, 110mm Wide, 5mm THIC



Fig 1 ASTM Standard size of the specimen

### B.2 Specimen Preparation

There are two types of preparation used in this study. One is treated specimen preparation and another one is untreated specimen preparation.

#### B.2.1 Untreated Specimen preparation

The specimens are not treated by any chemical process such as NaOH and HCL. Number of Specimens are carried out by this process is two. First the akund and palmyra fibers are taken in desired quantity. The mixing

composition is made as follows, (i) Akund(75%) and Palmyra(25%), (ii) Akund(25%) and Palmyra(75%). Then these fibers are cutted to 5mm thick. The Epoxy Resin (LY556) is taken into 100g with suitable hardener into 10g. Then the fibers are mixed with resin till to the heat is produced. Then the resin mixed fibers are placed in moulded specimen. This is for both mixing composition such as Akund (75%) and Palmyra (25%) and then Akund (25%) and Palmyra(75%). The hand lay up process as follows. Then the fibers were fully closed with mould. Then the fibers are left undisturbed at room temperature to allow in to dry under a weight of 5Kg

### B.2.2 Treated Specimen preparation

In this process, fibers are allow to treated with NaOH and HCL. Sodium hydroxide (NaOH) treatment removes impurities from the fiber surface, Hybrid fibers (Akund and Palmyra) sample were treated with different concentration of NaOH to soften the fibers and make it suitable for spinning. The concentration used were 5% and 10% with distilled water. Concentrated HCL is used in this process; the fibers are again treated with 25ml HCL. Because concentrated HCL was used to remove remaining impurities from the fiber's surface.

Table 1 Chemical treatment process with fiber composition

Fiber composition	Chemical Treatment 1	Chemical Treatment 2
75% Akund 25% palmyra	5% (5g NaOH) and 25ml HCL	10% (10g NaOH) and 25ml HCL
25% Akund 75% palmyra	5% (5g NaOH) and 25ml HCL	10% (10g NaOH) and 25ml HCL

## III. MECHANICAL

### TESTING A. Tensile test

A material is gripped at both ends by an apparatus, which slowly pulls the piece lengthwise until it fractures. The pulling force is called a load, which is plotted against the material length change, or displacement. The load is converted to a stress value and the displacement is converted to a strain value. If a composite material is pulled out until it breaks, a lot of information about the various strengths and mechanical behaviors of that material can be obtained. In this experiment, we will examine the tensile behavior of different composite fiber materials.



Fig 2 Tensile test specimens

**B. Impact test**

The Impact test is a dynamic test in which a V-notched test piece, gripped vertically, is broken by a single blow of a freely swinging pendulum. The blow is struck on the same face as the notch and at a fixed height above it. The energy absorbed is measured. This absorbed energy is a measure of the impact strength of material. Figure-5.3 shows the ASTM standard of impact test specimen.



Fig 4 Impact test specimens

**C. Flexural test**

In composite materials, specimen deflection is measured by the crosshead position. Test results include flexural strength and displacement. The testing process involves placing the test specimen in the universal testing machine and applying force to it until it fractures and breaks. The specimens used for conducting the flexural test are presented in Figure 4. The flexural test is performed on the Computerized



Fig 6 Flexural test specimen

**IV RESULTS AND DISCUSSION**

In the present study, akund and palmyra fiber reinforced the composite material, and their effect on mechanical properties is evaluated, and their properties are compared. The test results for the Tensile, Flexural, Impact tests of the composite samples are presented.

**A. Tensile test Result**

The various tensile loads applied to various compositions of composites are shown in fig.8. The different composite specimen samples are tested in the universal testing machine (UTM) and the samples are left to break till the ultimate tensile strength occurs. From the fig 8 to fig 9 is used to determine the peak load and tensile strength.

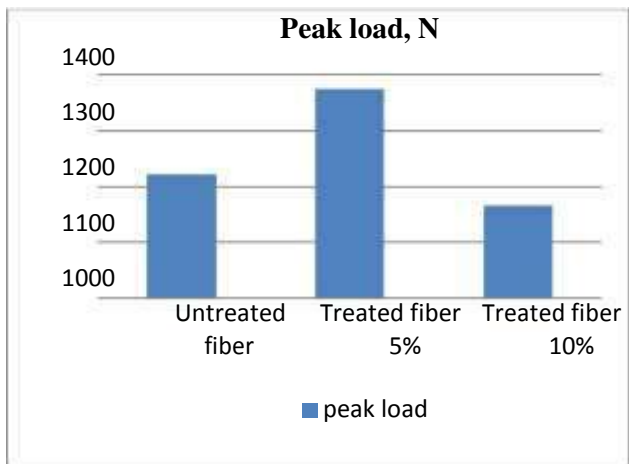


Fig 8 Tensile load test

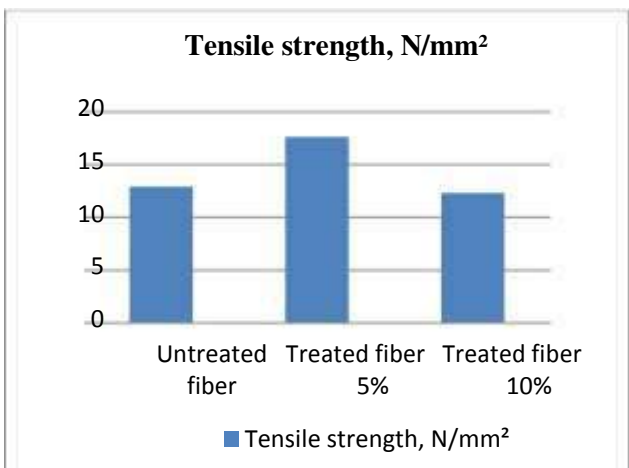


Fig 9 Tensile strength test

**B. Flexural test**

The various Flexural loads applied to various compositions of composites are shown in fig.10..

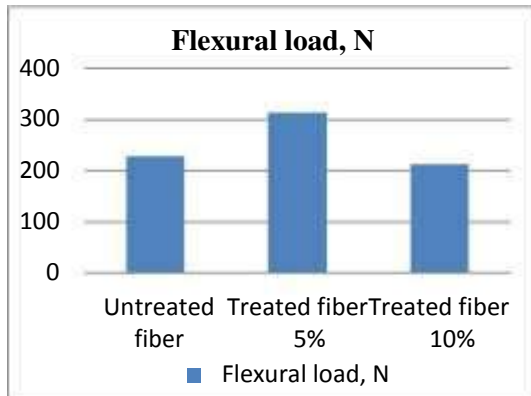


Fig 10 Flexural load test

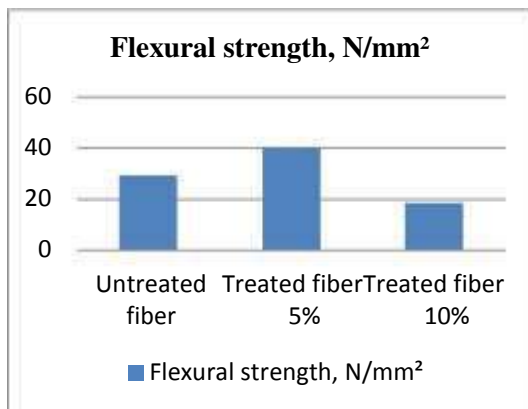


Fig 11 Flexural Strength test

**C. Impact test**

Izod Impact Test was carried out to determine the impact properties of the material. In this test, 5% had the highest Impact energy, and Non-treated fiber had the lowest Impact energy.

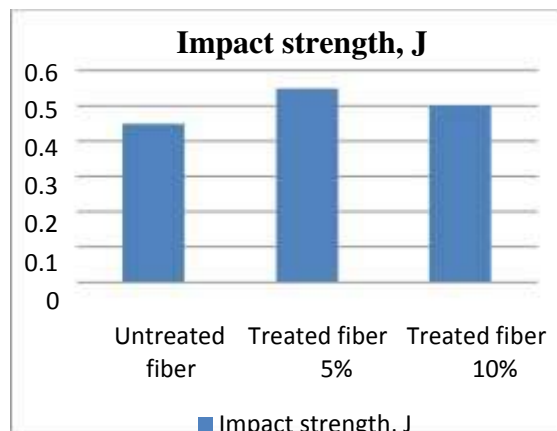


Fig 12 Impact strength test

**V CONCLUSION**

This experimental investigation and analysis of mechanical behavior of natural fiber reinforced polyester hybrid composites leads to the following conclusions:

- This work shows that successful fabrication of Akund and Palmyra reinforced polyester hybrid composites with different weight proportion of the fibers is possible by using simple hand lay up-technique.
- It has been noticed that the mechanical properties of the composites such as Tensile strength, Flexural strength and Impact strength etc. are greatly influenced by the fibers percentages.
- The result reveals that high tensile strength is 17.629N/mm<sup>2</sup> obtained for treated specimen because the Akund fiber percentage is more than Palmyra fiber has high tensile properties and also because these fibers are treated with 5% NaOH with 25ml HCL.
- For high Flexural Strength is 40.041MPa obtained for treated specimen, because the Palmyra fiber percentage is more than Akund fiber has good flexural properties and also because these fibers are treated with 5% NaOH with 25ml HCL.
- For high impact strength is 0.50J obtained for treated specimen, because the Akund fiber percentage is more than Palmyra fiber has a good impact properties also because these fibers are treated with 5% NaOH with 25ml HCL.
- From the present work it is concluded that the tensile strength and impact strength of composites depends on Akund fiber and flexural strength of composites depends on Palmyra fiber and also treated fibers are have more tensile, impact, flexural strength than the Untreated fibers.

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