Experimental and Investigation on Clutch Plate by using Natural Fiber Composites

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***Abstract*- Automobile Clutch plates performance on contact conditions at the pad to disc interface. The aim of this study is to analyze the effect of different material composition on friction & wear of Clutch Plate material. The review of paper is to represent a general study on the alternative material for the clutch plate material. In the present work, lotus fibre and palm fibre reinforced iso polymer composites were developed. The effect of fibre loading varying from on the mechanical properties of lotus fibre and palm fibre , iso polymer composite was studied. The study of mechanical properties of the composites was also investigated.**

1. INTRODUCTION

In order to converse natural resources and economize energy, reduction of wear has been the main focus of automobile manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The introduction of composite materials was made it possible to reduce the weight of clutch plate without any reduction on wear capacity and stiffness. Since, the composite materials have more elastics strain energy storage capacity and high strength to weight ratio as compared with those are being replaced by composite clutch plate.

1.2 CLUTCH PLATE- A **clutch** is a mechanical device that engages and disengages the power transmission, especially from driving shaft to driven shaft.

Figure1.2 Clutch plate

Clutches are used whenever the transmission of power or motion must be controlled either in amount or over time (e.g., electric screwdrivers limit how much torque is transmitted through use of a clutch clutches control whether automobiles transmit engine power to the wheels). In the simplest application, clutches connect and disconnect two rotating shafts (drive shafts or line shafts). In these devices, one shaft is typically attached to an engine or other power unit (the driving member) while the other shaft (the driven member) provides output power for work. While typically the motions involved are rotary, linear clutches are also possible. In a torque-controlled drill, for instance, one shaft is driven by a motor and the other drives a drill chuck. The clutch connects the two shafts so they may be locked together and spin at the same speed (engaged), locked together but spinning at different speeds (slipping), or unlocked and spinning at different speeds (disengaged).

2. COMPOSITE MATERIALS

Composite materials are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.
Typical engineered composite materials include:

- Composite building materials
- Reinforced plastics
- Metal Composites
- Ceramic Composites

Composite materials are generally used for buildings, bridges and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, storage tanks, imitation granite and cultured marble sinks and counter tops. The most advanced examples perform routinely on spacecraft in demanding environments.

2.1 *Composite building materials*

Concrete is the most common artificial composite material of all and typically consists of loose stones (aggregate) held with a matrix of cement. Concrete is a very robust material, much more robust than cement, and will not compress or shatter even under quite a large compressive force. However, concrete cannot survive tensile loading (i.e., if stretched it will quickly break apart). Therefore to give concrete the ability to resist being stretched, steel bars, which can resist high stretching forces, are often added to concrete to form reinforced concrete.

2.2 *Reinforced plastics*

Fibre-reinforcement polymers or FRPs include carbon-reinforcement polymers or CFRP, and or GRP. If glass-reinforcement polymers ossified by matrix then there are thermoplastic composites, short fiber thermoplastic, or long fibre-reinforced thermoplastics. There are numerous thermoset composites, but advanced systems usually incorporate armid fibre and carbon fibre in an epoxy resin matrix. Shape memory polymer composites are high-performance composites, formulated using fibre or fabric reinforcement and shape memory polymer resin as the matrix. Since a shape memory polymer resin is used as the matrix, these composites have the ability to be easily manipulated into various configurations when they are heated above their activation temperatures and will exhibit high strength and stiffness at lower temperatures. They can also be reheated and reshaped repeatedly without losing their material properties. These composites are ideal for applications such as lightweight, rigid, deployable structures rapid manufacturing and dynamic reinforcement.

2.3 *Metal Composites*

Composites can also use metal fibres reinforcing other metals, as in metal matrices' composites (MMC) or ceramic matrices composites (CMC), which includes bone and concrete. Ceramic matrix composites are built primarily for fracture toughness, not for strength. Additionally, thermoplastic composite materials can be formulated with specific metal powders resulting in materials with a density range from 2 g/cm³ to 11 g/cm³ (same density as lead). The most common name for this type of material is "high gravity compound" (HGC), although "lead replacement" is also used. These materials can be used in place of traditional materials such as aluminum, stainless steel, brass, bronze, copper, lead, and even tungsten in weighting, balancing (for example, modifying the centre of gravity of a tennis request), vibration damping, and radiation shielding applications. High density composites are an economically viable option when certain materials are deemed hazardous and are banned (such as lead) or when secondary operations cost (such as machining, finishing, or coating) are a factor. A sandwich structured composites is a special class of composite material that is fabricated by attaching two thin but stiff skins to a lightweight but thick core. The core material is normally low strength material, but its higher thickness provides the sandwich composite with high bending stiffness with overall low density.

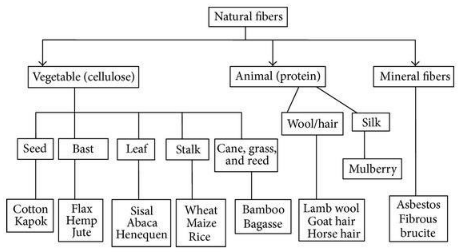
2.4 *Products*

Fiber-reinforced composite materials have gained popularity (despite their generally high cost) in high-performance products that need to be lightweight, yet strong enough to take harsh loading conditions such as aerospace components, boat and scull hulls, bicycle frames, swimming pool panels and racing car bodies. Other uses include fishing rod, storaging tank, swimming pool panels, and baseball bats. The new Boeing 787 structure including the wings and fuselage is composed largely of composites. Composite materials are also becoming more common in the realm of orthopedic surgery. Carbon composite is a key material in today's launch vehicles and heat shield for the phase of spacecraft. It is widely used in solar panel substrates, antenna reflectors and yokes of spacecraft. It is also used in payload adapters, inter-stage structures and heat shields of launch vehicle.

3. CLASSIFICATION OF FIBERS

Natural fibers include those made from plant, animal and mineral sources. Natural fibers can be classified according to their origin.

- ➢ Animal fiber
- ➢ Mineral fiber
- ➢ Plant fiber



3.2 *ANIMAL FIBER*

Animal fiber generally comprise proteins; examples mohair, wool, silk, alpaca, angora.

Animal hair (wool or hair)

Fiber taken from animals or hairy mammals. E.g. Sheep‟s wool, goat hair (cashmere, mohair), alpaca hair, horse hair, etc.

Silk fiber: Fiber collected from dried saliva of bugs or insects during the preparation of cocoons. Examples include silk from silk worms.

Avian fiber: Fibers from birds, e.g. feathers and feather fiber.

MINERAL FIBER

Mineral fibers are naturally occurring fiber or slightly modified fiber procured from minerals. These can be categorized into the following categories:

Asbestos

The only naturally occurring mineral fiber. Varietions are serpentine and amphiboles, anthophyllite.

Ceramic fibers:

Glass fibers (Glass wood and Quartz), aluminum oxide, silicon carbide, and boron carbide.

Metal fibers
Aluminum fibers

3.3 PLANT FIBER

Plant fibers are generally comprised mainly of cellulose: examples include cotton, jute, flax, ramie, sisal and hemp. Cellulose fibers servers in the manufacture of paper and cloth. This fiber can be further categorizes into following.

Seed fiber:
Fibers collected from the seed and seed case e.g. cotton and kapok.

Leaf fiber
Fibers collected from the leaves e.g. sisal and agave.

Skin fiber
Fibers are collected from the skin or bast surrounding the stem of their respective plant. These fibers have higher tensile strength than other fibers. Therefore, these fibers are used for durable yarn, fabric, packaging, and paper. Some examples are flax, jute, banana, hemp, and soybean.

Fruit fiber
Fibers are collected from the fruit of the plant, e.g. coconut (coir) fiber.

Stalk fiber
Fibers are actually the stalks of the plant. E.g. straws of wheat, rice, barley, and other crops including lotus and grass. Tree wood is also such a fiber. The natural fibers can be used to reinforce both thermosetting and thermoplastic matrices. Thermosetting resins, such as epoxy, polyester, polyurethane, phenolic, etc. are commonly used today in natural fiber composites, in which composites requiring higher performance applications. They provide sufficient mechanical properties, in particular stiffness and strength, at acceptably low price levels. Considering the ecological aspects of material selection, replacing synthetic fibers by natural ones is only a first step. Restricting the emission of green house effect causing gases such as CO_2 into the atmosphere and an increasing awareness of the finiteness of fossil energy resources are leading to developing new materials that are entirely based on renewable resources.

Applications of natural fiber composites
The natural fiber composites can be very cost effective material for following applications: Building and construction industry: panels for partition and false ceiling, partition boards, wall, floor, window and door frames, roof tiles, mobile or pre-fabricated buildings which can be used in times of natural calamities such as floods, cyclones, earthquakes, etc. Storage devices: post-boxes, grain storage silos, bio-gas containers, etc. Furniture: chair, table, shower, bath units, etc. Electric devices: electrical appliances, pipes, etc. Everyday applications: lampshades, suitcases, helmets, etc. Transportation: automobile and railway coach interior, boat, etc. Toys.

4. SELECTION OF MATERIALS

This chapter describes the details of processing of the composites and the experimental procedures followed for their mechanical characterization. The materials used in this work are

- lotus fiber
- palm fiber
- iso polymer

4.2 *LOTUS FIBER-* With the exhaustion of non-renewable resources such as coal, oil and natural gas, it has been a serious problem for people to look for alternative renewable resources. Cellulose materials are the cheapest and most abundant renewable resources in nature. In the view of environmental protection and sustainable development, the development and application of natural plant fiber and renewable fiber will be the inevitable trend.

Lotus plants spread across all over asian and other countries, with planting area about large hectares, Each year, after the flowering season, most of the lotus leaves and stalks are degraded naturally, which result in a waste of resource. Natural cellulose fibers produce from renewable plant resources, especially from crop residues can help to mitigate energy and environmental issues. There are a lot of fibers between lotus leaves and stalks, be easily to be obtained. And it is renewable, biodegradable, abundant in resources, more comfortable and skin- friendly than synthetic fiber . The application of lotus fiber can not only avoiding resources waste but also diversify the raw materials of textile products and promote sustainable development of textile industry. At present, there is little study done on the lotus fiber home or abroad, as it is a new kind of natural cellulose fiber.


STANDARD	VALUES
Density	1.184 g/cm³
Tensile strength	53 MPa
Young’s modulus	3.8 GPa
Elongation at break	2.75 %

4.1.2 PRO PER TIES OF LOT US FIBER

4.3 PALM FIBER

These fibers are known for their high durability and their resistance to sea water. Traditionally, palm fibers were used to make ropes for ship cordages which were proven to have good properties in sea water.

Fig Palm fiber

Other than that, the preparation for palm fibbers is effortless as the fibbers do not require any secondary processes such as water retting or mechanical decorticating process to yield the fiber. This is due to the fact that the fibbers, originally wrapped around the palm trunk from the bottom to the upper part of the tree as shown in Figure, are in the form of natural woven fiber.

The use of palm fiber has moved to another successive level specifically to various engineering applications. For example, it has been used in road constructions for soil stabilization as a substitute for geo textile fiberglass reinforcement. Apart from that, in certain circumstances, it is also being used for underwater and underground cables. Fibers in random original orientation mean that they are in their original layered shape straight from the tree trunk.

In the field of material engineering, palm fiber is being used as reinforcement in polymer matrix composites. Several studies have shown that sugar palm fibers have great potential to be used in many composite applications, just like other natural fibers such as kenaf, jute, oil palm, sugar cane bagasse, pineapple leaf and banana pseudo stem fiber. Study the effect of fiber content on mechanical properties, water absorption behavior and thermal properties of palm fiber reinforced plasticized starch composites. The composites were prepared with different amounts of fibers (i.e. 10%, 20% and 30% by weight percent) by using glycerol as plasticizer for the starch.

The mechanical properties of plasticized PS improved with the incorporation of fibers. Study on tensile properties of palm fiber (SPF) reinforced high impact polystyrene (HIPS) composites. Five different fibers loadings of 10, 20, 30, 40 and 50% by weight were mixed with HIPS polymer to form composites fabricated using melt mixer and hot press. Tensile tests of the composites were carried out using machine. The results showed that the increase of short PF loading in HIPS matrix improved tensile strength and modulus of the composites.

PROPERTIES	VALUE
Density	1.2-1.3 g/cm³
Tensile strength	220-240 MPa
Young's modulus	2.5-5.40 GPa
Elongation	2-4.50 %

4.2.1PROPERTIES OF PALM FIBER

4.3 ISOPOLYMER RESIN

ISOPOLYMERS are widely used in various industrial fields due to their merits, such as light weight, resistance to chemicals, resistance to the environment, easy processing, etc. It is difficult for polymers to be treated after use due to their resistance to the environment. When polymers are disposed of in natural environment, they remain for a long time without degradation. One of the solutions to this problem of polymers after use is the development of biodegradable polymers. Biodegradable polymers can be biodegraded eventually by microorganisms in the natural environment into carbon dioxide(CO2) and water (H2O). Various types of biodegradable plastics have been developed.

STANDARD	VALUES
Density (g/cm³)	1.15
Tensile strength (Mpa)	70-80
Young's modulus (Gpa)	3.5
Elongation at break (%)	4-6

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Tensile test is used to determine the tensile strength of the specimen, % elongation of length and % reduction of area. Tensile test is usually carried out in universal testing machine.

5. MECHANICAL PROPERTY TESTS

5.1 Tensile Strength

The tensile test of the composites was performed as per the ASTM D3039 standards. The test was done using a universal testing machine (Tinius Olsen H10KS).The specimen of required dimension was cut from the composite cast. The test was conducted at a constant strain rate of 2 mm/min. The tensile test arrangement is shown in figure

5.2 HARDNESS TEST

This gives the metals ability to show resistance to indentation which show it's resistance to wear and abrasion. Hardness testing of welds and their Heat Affected Zones (HAZs) usually requires testing on a microscopic scale using a diamond indenter. The Vickers Hardness test is the predominant test method

with Knop testing being applied to HAZ testing in some instances. Hardness values referred to in this document will be reported in terms of Vickers Number, HV.

5.3 WEAR TEST

Surface engineering point of view, wear test is carried out to evaluate the potential of using a certain surface engineering technology to reduce wear for a specific application, and to investigate the effect of treatment conditions (processing parameters) on the wear performance, so that optimized surface treatment conditions can be realized. In a pin-on-disc wear tester, a pin is loaded against a flat rotating disc specimen such that a circular wear path is described by the machine. The machine can be used to evaluate wear and friction properties of materials under pure sliding conditions. This test method describes a laboratory procedure for determining the wear of materials during sliding using a pin-on-disk apparatus. Materials are tested in pairs under nominally non-abrasive conditions. The principal areas of experimental attention in using this type of apparatus to measure wear are described. The coefficient of friction may also be determined.

6. ADVANTAGES OF FIBER COMPOSITE

- Chemical Resistance.
- Consolidated Parts and Function.
- Corrosion Resistance.
- Design Flexibility. Durable.
- High Flexural Modulus to Carry Demanding Loads. High Impact Strength.
- High Performance at Elevated Temperatures.

7. APPLICATIONS

- Automobile components
- Manufacturing industries

8. CONCLUSION

Traditionally **natural fibers** are used to make high strength ropes in South India. The results found that the mechanical properties have a strong association with the dynamic characteristics. Both of the properties are greatly dependent on the volume percentage of fibers. The composite having a **lotus and palm fibers** volume of showed a significant result compared to old clutch plate. It has been noticed that the mechanical properties of the composites material such as tensile strength, hardness and wear etc.

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