

# Design And Experimental Investigation Of Single Plate Clutch

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## Abstract

The Clutch Disk or plate is a part of the manual transmission system for your vehicle that delivers power from the engine to the transmission. It is mounted b/w the pressure plate & the Flywheel. For high-performance automobiles, it is constructed from highly durable steel or sometimes other material.

Performance of Vehicle Clutch plates on pad-to-disk interface touch conditions. The purpose of this study is to evaluate the impact on friction & wear of Clutch Plate material from the different material composition. If we use the composite material, the cost instead of the traditional material, weight can be reduced, and the life of the brake material can be extended at low cost. In our research, material strength is experimentally investigated to predict compression, tensile & impact testing in both materials (E-glass & Jute fibre) to choose the better material of single-plate clutch.

## I. INTRODUCTION

Single plate clutch is the most commonly used in automobile industries. It consists of a clutch plate, mounted on the clutch plate splines. The Flywheel is mounted on the crankshaft of the engine and in addition to that rotates.

### Clutch

The clutch is a mechanical device that precisely activates the transfer power from the driving shaft to the driven shaft by engaging and disengaging, as shown in the Fig.1. Typically one shaft is linked to an engine or another power unit (driving member) in these devices, while the other shaft (driven member) provides power output for the work. For construction and operation, the clutches used in an automobile are almost quite similar.

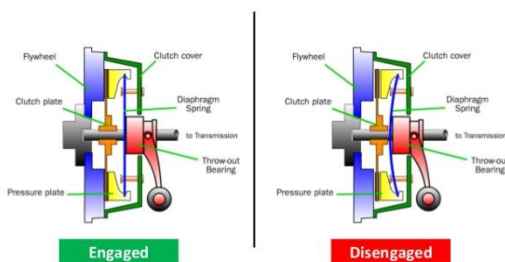


Fig. 1 Clutch Engaged & Disengaged Single Clutch Plate

The lightweight vehicles is one of the most widely used in the single plate clutches. The clutch helps transfer torque from the engine to the input shaft for transmission. It consists of an arrangement for clutch, friction plate, pressure plate, Flywheel, bearings, and clutch spring and multi-bolts. The single-plate clutch only has one plate that is mounted

on the clutch plate splines. One of the core components of the clutch is the single-plate clutch.

## II. LITERATURE REVIEW

**Girisha et al., (April 2012)** Sisal fibres, Coconut leaf sheath and Ridge gourd are effective reinforcement of polymers thus creating a range of technological applications beyond its traditional uses such as ropes, carpets, mats etc. The tensile strength increased by 65% (maximum) for the hybrid combination of Sisal and Ridge guard as reinforcements. Due to the low density of the natural fibres used compared to the synthetic fibres (Glass fibres, carbon fibres, etc...), the composites can be regarded as a useful lightweight Engineering Material.

**Kotreshsardar et al., (October 2014)** the tensile strength at 45% Sisal fibre reinforced polyester composite material is 59.86 N/mm<sup>2</sup>. By this, we can conclude that the experimental results for the tensile strength of specimen will match for femur tensile strength.

**Sreevani&Murali Mohan (September 2015)** Present used material for the clutch is Cast Iron. In this research, it is replaced with Aluminum alloy 7075, Aluminum metal matrix composite and composite material E – Glass Epoxy. The advantage of using aluminium alloys is their lightweight. The advantage of using composite material is their strength to weight ratio. By observing the static analysis results, the analyses stress values are less than the respective yield stress values of Aluminum alloy 7075, aluminium MMC and E – Glass epoxy. So using the materials is safe.

**Kannan et al., (2016)** the coconut shell the presence of hard element like MgO, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>



and Al<sub>2</sub>O<sub>3</sub>, as major constituents which can be used as particulate reinforcements in MMCs for automobile applications. The coconut shell ash can withstand a temperature of up to 1500°C with a density of 2.05g/cm<sup>3</sup>. That means this ash can be used in manufacture lightweight MMCs constituent with good thermal resistance. So we use Aluminium A360; silicon carbide and coconut ash to enhance the wear and mechanical properties of clutch

**Viswabharathy et al. (March 2017)** Clutch material widely used is Alloy steel. It is substituted with Gray cast iron, En-Gjs-400-15Steel, E-Glass Epoxy, Aluminum Alloy A360, Silicon Carbide and Kevlar 49 in this project. Friction plate selected and static and dynamic analysis was done to find complete deformation, equivalent stress (vonmises), and equivalent elastic Strain. By comparing the results, it is clear that Aluminium Alloy A360 has less deformation than other materials. So using the materials is safe. By comparing the results between materials, Aluminium Alloy A360 is more advantageous than other materials due to its less weight and high strength.

**PankajTripathi&KuldeepYadav (May 2017),** It is found that the tensile and flexural properties of bamboo/glass fibre hybrid composite are suitable for high flexibility & it can be concluded by finding such a value of tensile & flexural strength that the mechanical properties significantly influenced while using bamboo & glass fibre in such layer manner.

**MahendraSahu& Jain (June 2018)** We may infer that relative to cast iron, the sintered iron, kevlar and aluminium metal matrix composite shows less deformation value as well as less stress from static structural analysis. In addition,aluminium metal matrix composite has a very high strength to weight ratio compared to cast iron, and hence cast iron can be replaced by aluminium metal matrix. Aluminium metal matrix is better than all three other materials.

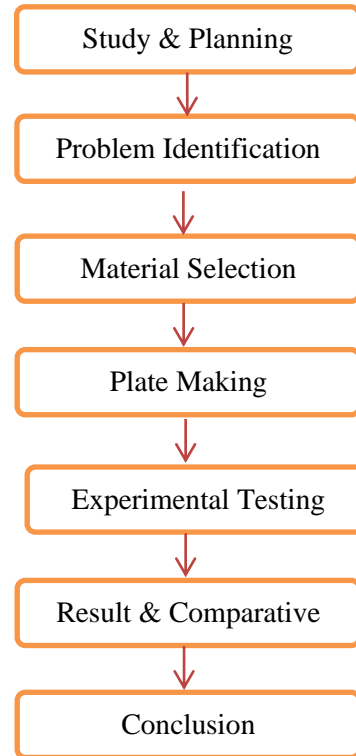
**Venugopal Naidu & Deva Kumar (July 2018)** The Von-mises stresses calculate for Tungsten carbide, Nickel material, Aluminum alloy 6061A, Kevlar 49 and E-glass epoxy composite as a facing material. The stresses for the material mentioned above for the friction facing component is nearly the same. The capacity of Torque transmission for Nickel material is more when compared with other friction materials, and also Nickel material withstands high temperature and pressure.

**KunchalaBrahmaiah&Hemalatha (October 2018)** the Static structural analysis and Modal analysis of the clutch plate by changing circle diameter and applying two types of materials. During the activity, this project will find the stresses, deformations and frequencies in the failure zone. It also suggests design modifications to improve the lifetime of the clutch plate.

**Manivannan et al., (2018)** traditionally natural fibres are used to make high strength ropes in

South India. The results found that mechanical properties have a strong association with dynamic characteristics. Both of the properties are greatly dependent on the volume percentage of fibres. The composite has a lotus, and palm fibres volume showed a significant result compared to the old clutch plate.

### III. WORKING METHODOLOGY



### IV. COMPOSITE MATERIAL & PLATE MAKING

A Composite Material (also known as a lightweight material or shortened to a composite) is a material combination of the plate makesatwo or more composite materials with different physical or chemical properties that, when mixed; create a material with different properties from the individual components.Theconcentration in Jute Composite materials enhanced by Natural Fibre is growing rapidly. We are fully or partially renewable, inexpensive, and biodegradable.A Fibre Reinforced Composite (FRP) is a composite material composed of a polymer matrix embedded in high-resistance fibres such as glass, aramid and carbon.The manufacture of a composite fibre requires the combination of natural fibre (reinforcement) and polymer (matrix), both of which are the building blocks of any composite material.Hand-Layup technique, which involves the combination of natural fibres (reinforcement) with the polymer (matrix), is the simplest procedure used to create the natural composite.Natural fibre layers are placed in a mould and on each layer resin is poured so that all layers are sealed.A roller is then used to roll over in such a way

that all materials are well coated, and extra resin falls out—left without disruption until the composite is finished.

**Fabrication Process**

We implement the most widely utilized manufacturing processes. Though there are many variations on these techniques, this summary gives a good indication of the possibilities of development.

**Hand lay-up technique**

The fibres are cut and put in a mould, usually mats; rollers will apply the resin. The benefits are the high flexibility and process efficiency and low-cost tooling. The long development time, the labour-intensive nature, and low automation possibilities are considered drawbacks.



**Fig. 2 Hand lay-up technique**

**Specimen making process**

In our project, we made two different composite material plates make for their size of 300 x 300 x 3mm thickness. The specimen identification details are mention in the Table1. The comparatively natural fibre (Jute Fiber) & synthetic fibre (Glass Fiber)

**Table 1 Specimen identification details**

S. No	Specimen type	Reference no
1.	Jute Fiber	411-1
2.	Glass Fiber	411-2

**V. EXPERIMENTAL WORK**

In our project is mainly focused on both natural & synthetic fibre materials plates makes & predict the experimental testing in standard size specimen.

- Compression test
- Tensile test
- Impact test

**Compression test**

- Machine name: Computer-controlled Universal Testing Machine.
  - ✓ Cross Head Speed 0.5 mm to 200 mm per min.
  - ✓ Ball Screw Drive.
- Capacity: 100kN
- Make Fine Testing Machine.



**Fig. 3 Tensile and compression test carried on laboratory**

**Table 2 Compression test reading**

S. No	Specimen 411-1		Specimen 411-2	
	Load (kN)	Displacement (mm)	Load (kN)	Displacement (mm)
1.	2	0.56	0.5	0.15
2.	4	1.24	1.0	0.23
3.	6	1.90	1.5	0.33
4.	8	2.59	2.0	0.41
5.	10	3.41	2.5	0.52
6.	12	4.28	3.0	0.61
7.	13.4	4.65	3.5	0.73
8.	-	-	4.0	0.83
9.	-	-	4.5	0.95
10.	-	-	5.0	1.02

The compressive load was applied on the composite using UTM Machine. The mechanical properties, such as ultimate breaking load-displacement at maximum force & tabulated in Table 2. The natural fibre is high load withstand, but maximum deformation in natural fibre compared to the synthetic fibre.

**Tensile Test**

To study the tensile property of the material test sample is prepared as per ASTM standards with the help of a counter cutter. The prepared specimen is loaded in the Universal testing machine & tensile load is observed during the test. During the test, the crosshead speed is taken as 2 mm/min as per ASTM standards. Following graph shows the tensile property of the specimen

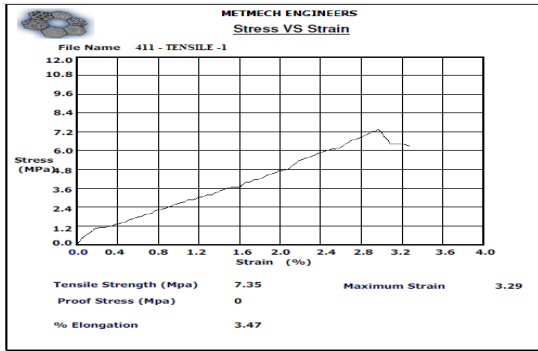


Fig. 4 Stress vs Strain on specimen 411-1

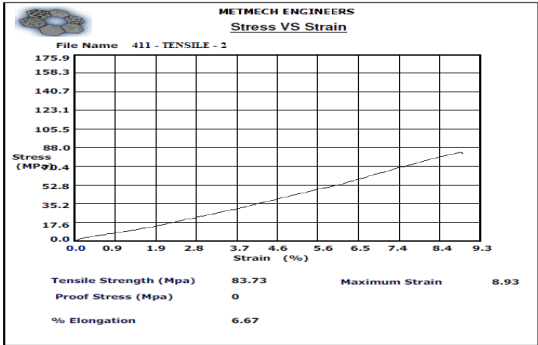


Fig. 5 Stress vs Strain on specimen 411-2

The high tensile strength & elongation obtained in the synthetic fibre compared to the natural fibre. It's graphically represented to Fig. 4 & 5.

**Impact Test:**

The impact property of the different specimens an impact test is carried out. Impact test carried out for the present study is Charpy impact test machine graphically represented in Fig. 6.



Fig. 6 Charpy impact test machine

The energy loss is obtained from the Charpy impact machine. The impact response in Jute & Glassfiber composites of Charpy impact test is presented. The results indicated that the maximum impact strength is obtained below.

**Table 3 Impact test result for specimens**

S. NO	Specimen ID	Specimen size (mm)	Joules (J)
1.	411-1	250 x 25 x 3	2
2.	411-2	250 x 25 x 3.2	5.8

From the result, we predict the maximum strength obtained in the glass fibre material compared to the jute fibre. The synthetic fibre is suitable for single plate clutch.

By implementing this alternate material, we reduce the production cost of a single plate clutch, more flexible, high strength, less weight, etc.

**VI. ADVANTAGE & APPLICATION**

**ADVANTAGES**

- Single Plate Clutch is not expensive.
- It has little maintenance.
- The composite material is lightweight & fuel consumption is less

**APPLICATION**

- Single plate clutches are used in trucks, vans, automobiles and so on.
- Single plate clutches used where there is considerable radial space.
- Because enough surface area is available in single plate clutches for heat dissipation, no cooling oil is necessary. Single platform clutches are dry style, therefore.

**VII. CONCLUSION**

The production of composite materials has provided various possibilities for vehicle weight reduction to the automotive industry. Generally the selection of materials in automobiles plays a vital role in it. The material which has been selected should have good mechanical characteristic and less in cost. In this experiment, we have suggested that the fibre composites are best suitable for automobile clutch plate compare to the exiting clutch plate materials.

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