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EXPERIMENTAL INVESTIGATION OF SINGLE PLATE CLUTCH USING NATURAL FIBERS

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ABSTRACT

A clutch is a machine component that connects a driving shaft to a driven shaft, allowing the driven shaft to be started and stopped at will while the driving shaft remains stationary. An interruptible linkage between two spinning shafts is thus provided by a clutch. Cast iron and aluminium alloys are currently used as friction disc materials. The aim of this research is to look at how different material compositions affect clutch plate friction and wear. Natural fibre composite fabrics are used in this investigation. Because of their high strength-to-weight ratio, composite materials are considered. Jute fibre and Aloe Vera fibre are used as composite materials in this plant. A single plate clutch is experimental investigation effect of fiber loading varying from on the mechanical properties of Jute fiber and Aloe Vera fiber composite was studied.

Keywords:

INTRODUCTION

Awareness of wear has become the primary priority of car makers in the current scenario in order to save natural resources and save electricity. Weight loss can be accomplished mainly by the use of superior materials, design optimization, and improved production methods. With the use of lightweight materials, the weight of the clutch plate may be reduced without sacrificing wear capability or stiffness. Since composite materials have a higher strain energy storage ability and a more strength-to-weight ratio than the materials that are being replaced by composite clutch plates, they are more elastic and have more strength-to-weight ratio.

LITERATURE REVIEW

Vishal J. Deshbhrata (October 2013) "Single Plate Friction Clutch Design and Structural Analysis" After completing the study in CAE applications, such as ANSYS 9.0, The appropriate stresses for the same material under the applied conditions are clearly smaller than the equivalent stresses for material loading conditions, meaning that the product will not yield and the norm will remain unchanged. The outcome was very favourable, as predicted. R.Gobinath, A.Karthik (June 2016) "Design and Analysis of Friction Plate In Single Plate Clutch Using Alumina" As a result, We concluded that the single plate clutch transmitting 85KW power technically, the output of different asbestos and alumina single plate clutches, the alumina within the safe limit, and is used as a single plate clutch material. As compared to asbestos, the design parameters of alumina, such as displacement, ultimate tension, and temperature created, and heat flux, are found to be healthy.

Rakshit kumar (March 2018) "Stress and thermal analysis of clutch plate" After running the

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stress & thermal analysis in ANSYS 16.0, The appropriate stresses for the designs in question are clearly lower than the corresponding stresses for material loading conditions. None of the parts will yield under these loading conditions, indicating that the design is safe. Although the three design variants have equal factors of protection, the 3rd design variant has the maximum factor of safety. M.venugopal naidu (july 2018) "Structural and thermal analysis of single plate friction clutch with different materials" The friction facing plate in a single plate friction clutch is critical for torque transfer from the engine to the transmission mechanism. While the clutch pedal is miserable, the clutch is engaged with the flywheel; but, The clutch is detached while the clutch pedal is miserable, resulting in a rapid increase in temperature. Friction between mating components causes the object to wear out.

PROBLEM IDENTIFICATION

It has high brittleness, corrodes easily, difficult to weld and expensive. These are problems in cast iron and aluminium alloy clutch.

OBJECTIVE

These causes cast iron and aluminium alloy material is replaced by composite material jute fibre and aloe Vera. It is experimental investigation of single plate cultch projects using composite materials

MATERIAL SELECTION

EXISTING MATERIAL

Aluminium Material

Aluminium has a density of 2.7 g/cm3, which is almost 1/3 that of steel (7.83 g/cm3). Steel weights around 490 pounds per cubic foot, A cubic foot of aluminium weights about 170 pounds. This light weight, combined with the high strength of some aluminium alloys (which exceeds that of structural steel), allows for the design and construction of solid, lightweight structures that are especially useful for anything that moves spacecraft and aircraft, in addition to all forms of land and water vehicles.

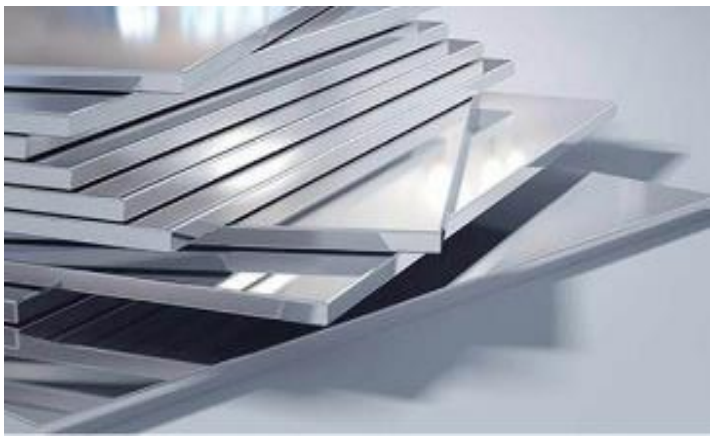

Fig. 1 Aluminium Material

Mechanical properties of aluminium

- Density - 2770 kg/m3
- Young modulus - 85000 Mpa
- Poisson ratio - 0.33
- Thermal conductivity -175 W/m K
- Specific heat -875 J/kg k

Cast Iron Material

Cast iron is a category of iron-based alloys with a carbon content greater than 2%. Its usefulness is due to the fact that it melts at a low temperature. As the material breaks, White cast iron has carbide impurities that allow cracks to move straight through, while grey cast iron has graphite flakes that redirect a passing crack and release an infinite number of fresh cracks, Spherical graphite "nodules" in ductile cast iron inhibit the crack from progressing.

Mechanical properties of cast iron

- Density - 7200kg/m3
- Young modulus - 110000Mpa
- Poisson ratio - 0.28
- Thermal conductivity - 52 W/m K
- Specific heat - 447 J/kg k

PROPOSED MATERIAL

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Jute Fiber

Jute is a smooth, lustrous bust fabric that can be woven into thick, sturdy threads. It is mainly made from plants in the genus Corchorus, which formerly known as part of the Tiliaceae family. While inferior to Corchorus capsularis, Corchorus olitorius is the primary source of thread. "Jute" refers to the plant or fibre that is used to make burlap, hessian, and gunny cloth.

Properties of jute fiber

- Density - 1300 kg/(cm3)
- Young modulus - 55 GPa
- Tensile strength - 300 GPa
- Shear modulus - 7.45 Gpa

Aloe Vera fibre

Aloe vera is a succulent herb belonging to the Aloe family. It is an evergreen perennial that hails from the Arabian Peninsula but thrives in tropical, semitropical, and arid climates all over the world. It's grown for both agricultural and medicinal purposes. The species is often used as a decorative plant and can be grown successfully as a potted plant indoors.

It can be used in a variety of consumer goods, such as snacks, skin lotions, cosmetics, pointers, and a gel for mild burns and sunburns. There is no scientific evidence that Aloe vera extract is beneficial or healthy as a cosmetic or medication.

Properties of jute fibre

- Density - 267 kg/ (cm3)
- Young modulus- 3.91 GPa

EPOXY RESIN

Epoxy refers to any of the basic components or cured end products of epoxy resins and is a colloquial term for the epoxide functional group. Epoxy resins, also known as polye poxides, are a mix of reactive pre-polymer and polymer containing epoxide.

Fig. 2 Epoxy Resin

DESIGN OF SINGLE PLATE CLUTCH

A concept is a blueprint or specification for the construction of an object or system, or the result of that blueprint or specification in the form of a prototype, feature, or process. The term "to plan" refers to the act of making a design. Direct creation of an object without a clear prior plan (as in craftwork, some architecture, coding, and graphic design) may be considered a design practice in some cases.

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Fig. 3 Single Plate Clutch

CAD (computer aided design)

Computer-aided design (CAD) is the use of computers (or workstations) to assist in the creation, modification, analysis, or optimization of a design (CAD). Designers use CAD tools to increase their performance, design accuracy, coordination by reporting, and the creation of a production database. Common CAD outputs provide electronic files for printing, machining, and other industrial activities. Another language used is CADD (Computer Aided Design and Drafting).

INTRODUCTION OF SOLID WORKS

Solid Works is a computer programme for modelling, CAD, and CAE that operates primarily on Microsoft Windows. Although solid works can be run on MacOS, it is not supported by. Dassault System publishes Solid Books. According to the publisher, strong works was used by over two million engineers and designers at over 165,000 businesses in 2013. According to the firm, income for solid works in fiscal year 2011-2012 was $483 million.

With its integrated analytical methods and design automation, SOLIDWORKS is a highly efficient 3D CAD development interface that can be used to enact physical behaviour as an example kinematics, dynamics, stress, deflection, vibration, temperatures, and fluid flow in order to satisfy any kind of architecture.

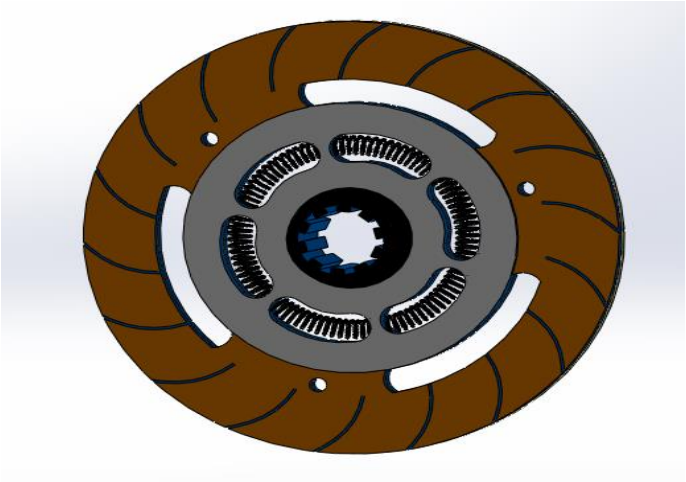

Fig. 4 3d Model in Solid Works

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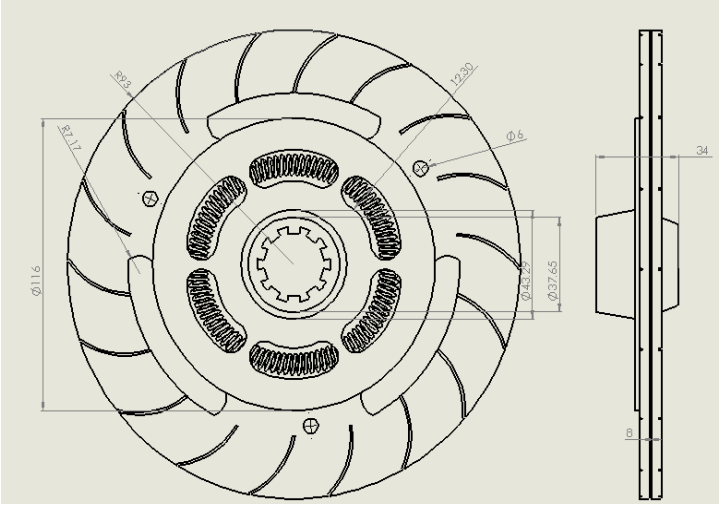

Fig. 5 Dimension in Single Plate Clutch

RESULT AND DISCUSSION

Two different materials with various percentages of fibres are used for making polymer matrix composite. Here we are going to testing three specimens and that is having various composition ratios such as Aloe Vera (100%), Aloe Vera +Jute and Jute (100%).

Table. 1 Material Composition

S.NO	MATERIAL	SAMPLE ID
1	Aloe Vera (100%)	A8
2	Aloe Vera +Jute	A9
3	Jute (100%)	A10

Fig. 6 Aloe Vera polymer matrix composite

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Fig. 7 Aloe Vera +Jute polymer matrix composite

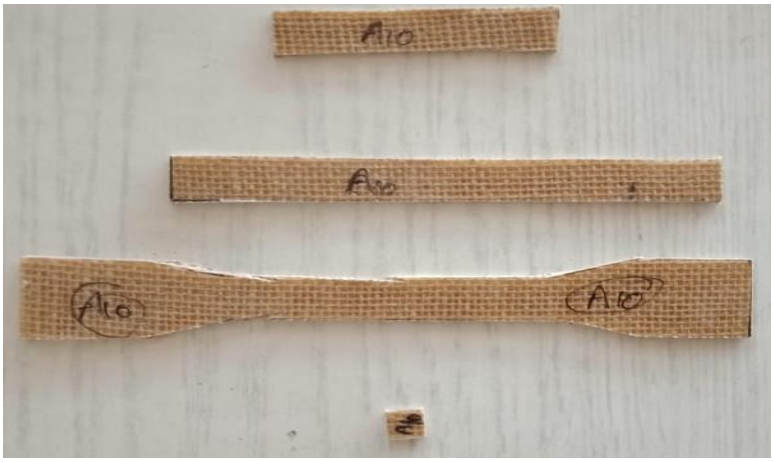

Fig. 8 Jute polymer matrix composite

Tensile test result

The samples were cut as per ASTM standard in size of 165 mm X 25 mm X 3 mm shown in Figure 6.4. Regular "dumbbell" or "dog bone" shaped specimens are used in this test process. A universal measuring machine was used to determine the tensile power. The whole collection of specimens used for the Tensile test. The samples were exposed to constant tensile loading until they failed. Table 6.2 indicates the specimens' elongation and Ultimate Tensile Stress as well as the load at which they failed. From the test results it is clear that the specimen A9 has the minimum elongation i.e, 5.2 and Sample A10 has maximum tensile strength i.e., 63.455 N/mm^2.

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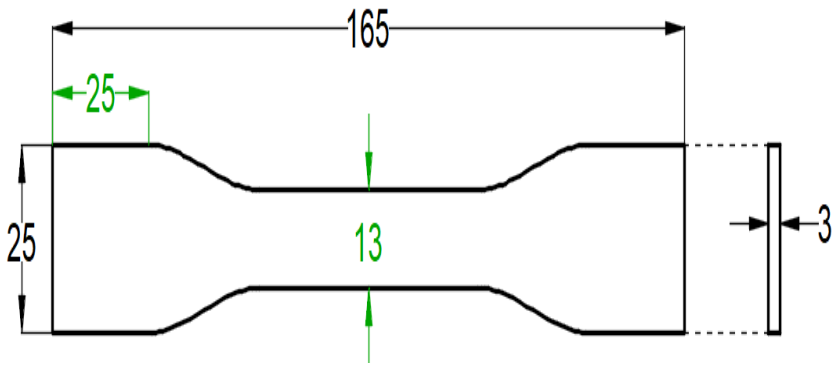

Fig. 9 Tensile test specimen

Table. 2 Tensile result of specimens

Sample ID	C.S Area (mm^2)	Peak Load (N)	% Elongation	Ultimate Tensile Stress (N/mm^2)
A8	45.00	1492.444	7.690	33.168
A9	45.00	1519.020	5.200	33.756
A10	45.00	3125.603	6.590	69.455

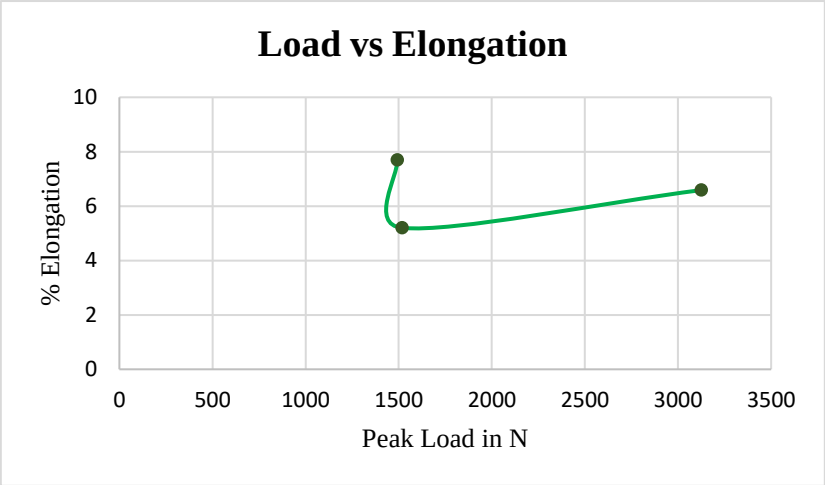

Fig. 10 Load vs Elongation

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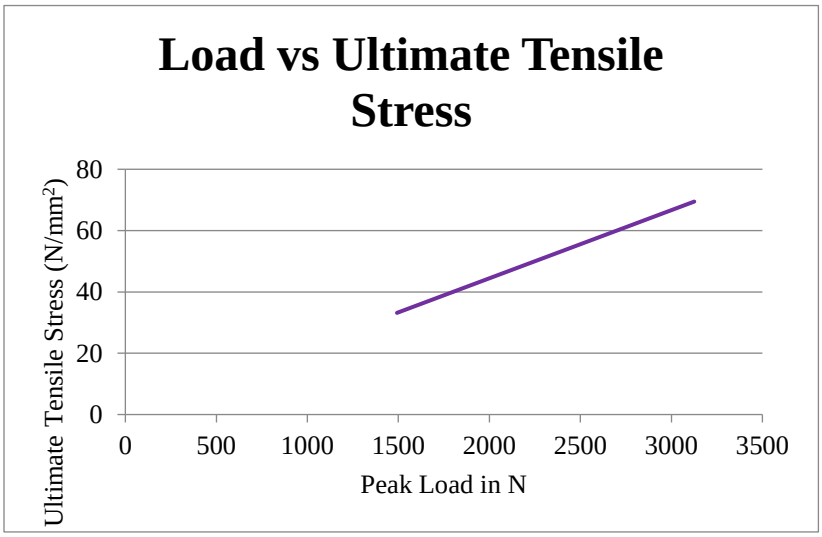

Fig. 11 Load vs Ultimate Tensile Stress

IMPACT TEST

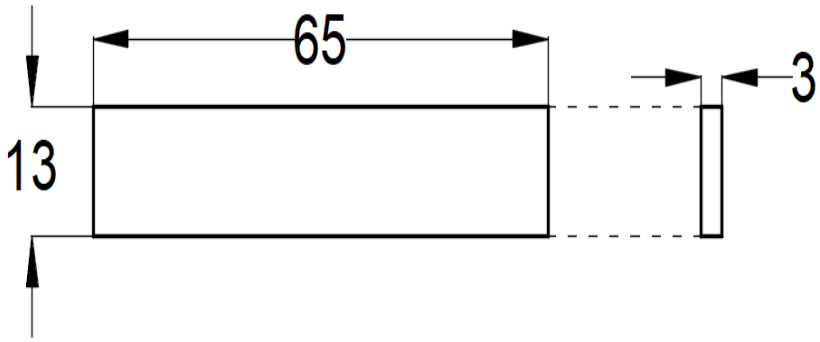

Fig. 12 Impact test specimen

All samples were cut and prepared according to ASTM in size of 65mm X 13mm X 3mm. An Izod measuring system was used to determine the impact power. The whole collection of samples used for the Impact evaluation. Impact was applied to the samples, which were suddenly loaded before failure occurred. When a malfunction occurs while under load, the results are registered. Table 6.3 shows the impact score of the specimens, with A9 having the highest impact level of the impact test specimens.

Table. 3 Impact test result

Sample ID	IZOD Impact Value (Joules) for thickness of 3mm
A8	0.80
A9	0.35
A10	0.40

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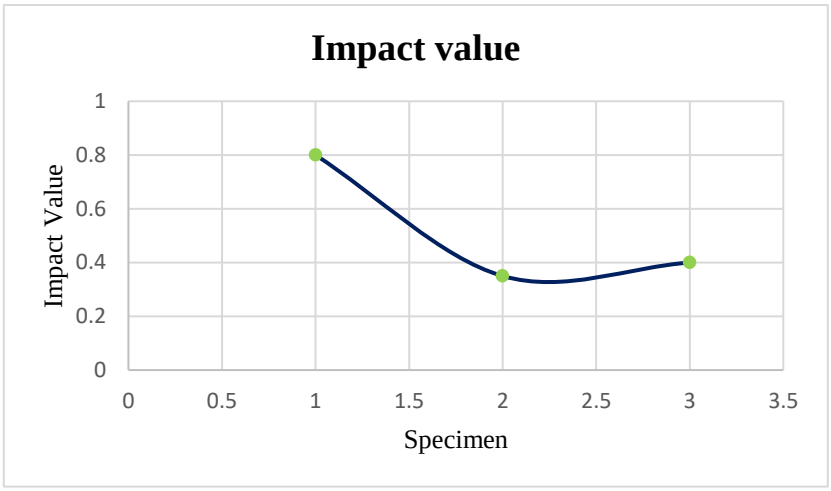

Fig. 13 Impact Value

FLEXURAL TEST

A flexural examination is most often used to determine flexural ability. The flexural test calculates how much force is needed to bend a beam when loaded in three directions. Flexural strength test of composites are carried out as per standard ASTM in size of 125mm X 13mm X 3mm. This research is carried out on a universal measuring unit. The specimen is shown in Figure: 6.9. Flexural test results are tabulated in below. From the flexural test specimen A9 has maximum flexural strength i.e., 101.791 MPa and specimen A10 has high flexural modulus.

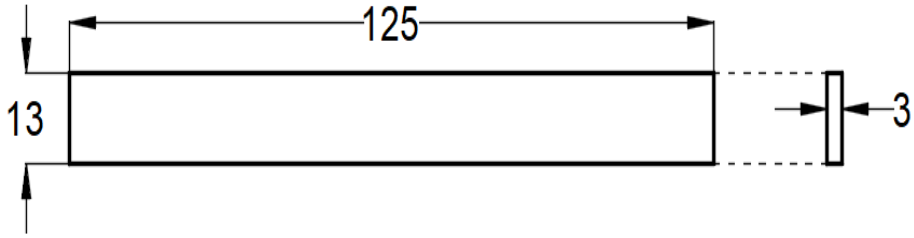

Fig. 14 Flexural test specimen

Table. 4 Flexural Test Result of Specimens

Sample ID	C.S Area (mm^2)	Peak Load (N)	Flexural Strength (MPa)	Flexural Modulus (GPa)
A8	39.00	17.481	11.206	380.253
A9	39.00	158.794	101.791	5740.474
A10	39.00	102.209	65.541	7036.325

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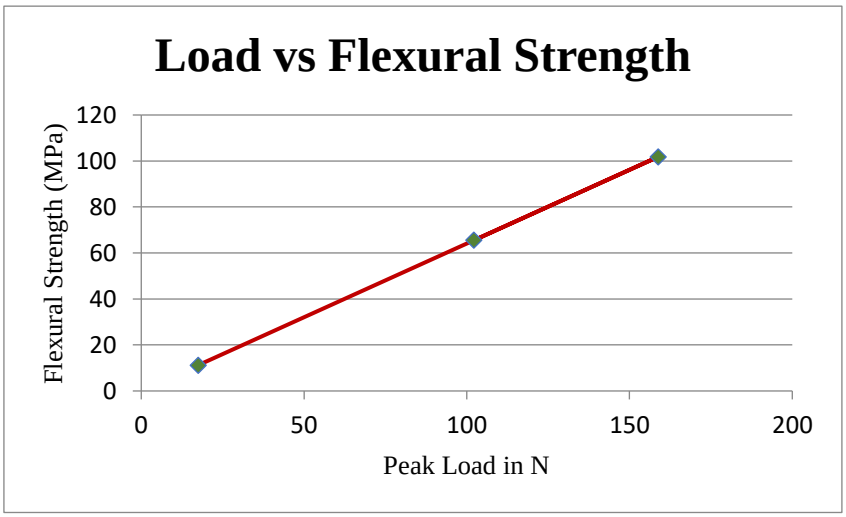

Fig. 15 Load vs Flexural Strength

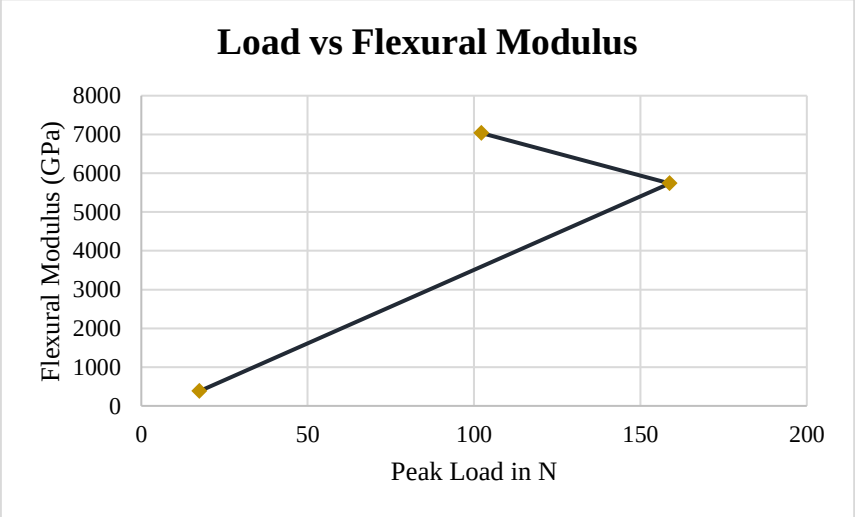

Fig. 16 Load vs Flexural Modulus

HARDNESS TEST

All samples were cut and prepared according to ASTM in size of 65mm X 13mm X 3mm. Hardness test of composites are carried out as per standard ASTM. This research is carried out on a universal measuring system. The specimen is shown in Figure: 6.11. The hardness of specimens for each fibre is tabulated in the table below. Load and hardness relations are graphically represented. From the table we can see that the specimen A10 has maximum hardness value i.e. 22.1 H.

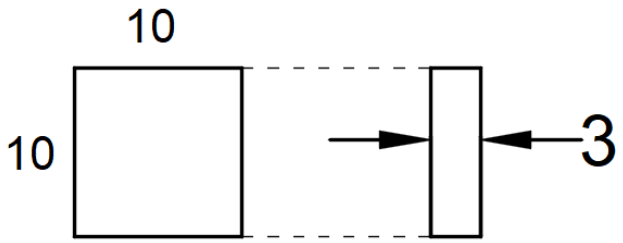

Fig. 17 Hardness test specimen

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Table. 5 Hardness test results of specimens

Sample ID	Micro Hardness (Vickers) HV (H)	Average Value HV (H)
A8	21.6	21.6
	21.4	
	21.8	
A9	21.9	21.7
	21.8	
	21.6	
A10	22.2	22.1
	22.3	
	22.0	

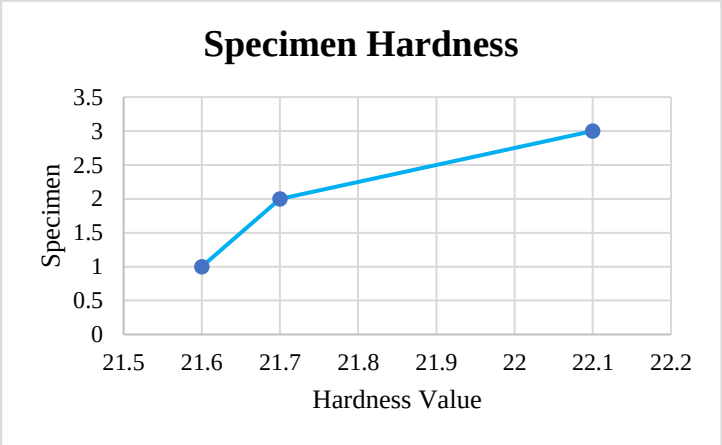

Fig. 18 Hardness Test Result

CONCLUSION

The use of Aloe Vera and Jute to make polymer reinforced fibre composites is investigated experimentally. The variation of mechanical properties for the various ratio of fibre used has also been studied. The composites are made using aloe vera, jute and epoxy resin by hand lay-up method for 3 different ratios. Specimen A8 with 100% aloe vera content has excellent impact value i.e., 0.8. Specimen A9 with aloe vera and jute content has maximum flexural strength and less elongation i.e., 101.791 MPa and 5.2. Specimen A10 has excellent tensile strength and hardness, that values are 69.455 N/mm2 and 22.1 H respectively. from the all result specimen A10 is has strength in flexural and impact also, so it is suitable for alternative material of single plate clutch. And it reduce the weight of the component, enhance the performance of clutch plate.

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