ISSN: 2455-9679
Impact Factor: 3.340

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"STATIC STRUCTURE ANALYSIS OF MULTIPLATE CLUTCH WITH DIFFERENT FRICTION MATERIALS: A REVIEW"

Mayank Chouhan [1], Dheeraj Mandliya [2], Vikas Sharma [3]

[1] *M. Tech Scholar, Department of Mechanical Engineering, Malwa Institute of Technology, Indore*

[2,3] *Assistant Professor, Department of Mechanical Engineering, Malwa Institute of Technology, Indore*

ABSTRACT

Clutch is a mechanical instrument. It's a system that engages to continuous the effluent of power from engine to gearbox and disengages to cut the power from engine to gearbox. It is mounted in the central of the gear assembly and engine. A multiplate clutch is important roles in the gear box. Good design of clutch gives superior engine performance. Multiplate clutch is extremely used in motorcars, motorbikes, and heavy-duty vehicles. Whenever high torque transmission be expected and restricted place is available. The inside disc is made of steel and outside disc is made of bronze. The material used for the lining of friction surface is Asbestos, Ceramic, Kevlar, Cork, Sintered Iron, Cast iron, and Powder metal. The multiplate clutch has designed in creo parametric and imported in ANSYS workbench 19.2 for automotive application. The structural analysis is implemented for the friction material clutch plate. The result of friction material is depend on static structural analysis, stress, total deformation, strain of the friction plate. Structural analysis is performed for a clutch plate using properties of the material. Material used for Kevlar, Sintered Iron, Nickel, SF001. A comparison result is performed for the materials to recognized better lining materials for the clutch plate.

Key Words: *ANSYS, CREO, Kevlar, Nickel, Sintered iron, SF001, Stress, Strain, Total deformation.*

I. INTRODUCTION

The clutch is a mechanical instrument. The transmission system is used in the vehicle to engage and destroy the transmission system from the engine. The friction clutch is a necessary part of any automotive machine. The clutch is placed in the central of the engine and the transmission system. Which conducts power, as torque from engine to gear assembly. At the point when the clutch is set up, the engine will be associated with the transmission, and force will drift from the motor to the closest wheels by means of a transmission system. Furthermore, as soon as the clutch is disengaged, on hold down the clutch pedal will cause the engine to disengage from the transmission. In this way, the power does not reach to rear wheel. While the engine is even now running. There are two types of clutch. First, single plate clutch and second is multiplate clutch. Single plate clutch is utilized in small duty vehicle and the multiplate clutch is utilized in car, bike and heavy-duty vehicles. It consists of more than one set of pressure plate and friction plates. As the quantity of plates increased, the friction surface as well increased. The increase quantity of friction surfaces increased the competence of the clutch to transmit torque. The friction between to surface depend upon pressure applied on them, area of friction. Generally, there are two types of clutch depending on the nature of contact. 1-positive clutch 2- friction clutch.

ISSN: 2455-9679
Impact Factor: 3.340

Required of good clutch facing: -

1- Relatively high coefficient of friction.
2- It should have high heat resistance
3- It should be easy to manufacture.
4- Must have sufficient shear strength to transmit torque.
5- Friction property must be maintained over the entire working life.

1.1 Working principle of clutch

Clutch works on the theory of friction because were the two-rough surface. Clutch plates come into link with each other and are pressed so that the friction among them causes the composite. One is circled the other will also circled. Then they become to around as a single unit. The friction between two surfaces depends on the area of the surface, the pressure applied them, and the coefficient of friction of the surface materials.

Figure 1. Multiplate Clutch

1.2 Objectives

The objectives of this task are to demonstrate the structural analysis of the clutch plate with different friction linings and to choose the most convenient one.

- Solid modeling of multiplate clutch assembly.

➢ ***Objectives of Multiplate clutch***

- Resolution of intensity of axial pressure according to rated torque.
- Resolution of von mises stress.
- Resolution of von mises strain.
- Resolution of total deformation.

Comparison of the design parameters.

ISSN: 2455-9679
Impact Factor: 3.340

II. LITERATURE REVIEW

2.1. Review of Related Literature

Man's quest for reclamation has never been satisfied. The drive towards better and greater technical and technological results has made the world active. Before now, some scientist and engineers have done a lot of work as respect the Multiplate Friction clutch. A review of some of that works gives the design and erection of a Multiplate Friction clutch.

2.2 Literature Review

Modeling and analysis of multiplate clutch by aniruddha joshi, aniket bharambe **[1]** Multiplate clutch is important feature of power transmission system. A good design of clutch gives good engine performance a designed multiplate clutch by using formulas. Model is design in catia v5 and imported in ansys. In this paper the materials SF-MC2 and sintered iron has been selected and it is clear the SF-MC2 is better materials for clutch friction lining then sintered iron.

Static structure analysis of multiplate clutch with different friction materials by Santosh Ukamnal, prop. P baskar **[2]** A modeling of clutch in creo software and structural analysis of clutch is done with cork, copper, Sa92. The analysis is approved out on ansys workbench. Specification of multiplate clutch is obtained from the pulsar DTsi model and conclude that the materials SA92 is better than copper and cork.

Modeling and FEA of multiplate clutch by using materials for optimum torque transfer capacity of TCT system of green and light vehicle by seyoum kebede **[3]** Modeling and analysis of multiplate clutch to use in the tin clutch transmission (TCT) system. The static structure and dynamic analysis were carried out for clutch plate by using FEA. 3D model design in solid works and using different materials for analyzing. Aluminum alloy, E glass epoxy, and grey cast iron by comparison E Glass Epoxy is better than other.

Optimal design and analysis of multiplate friction plate using creo and FEA package by pilavarthi krishram raju **[4]** Clutch is an essential part. It is placed in engine box.it is used in heavy duty vehicle. A design of pressure plate by using empirical formula and modeling of pressure plate in creo and analysis in ansys software and best material was taken out with good model will suggested to the company.

Design and fatigue analysis of multiplate clutch by Dr. Ch. S Naga Prasad **[5]** In this thesis, fluid plays on important role in clutch so many properties of clutch and some losses of clutch design. In this paper modeled design by using formulas and 2d and 3d models are design in Pro/E and analysis is done in ansys software for better friction lining materials. It will focus on the thermal and CFD analysis. Thermal analysis is done for the multiplate clutch steel, brass at different heat temperature. Heat flux valve is more for brass materials that steel and brass materials is better for multiplate clutch.

Design and analysis of clutch using sintered iron as a friction material by Mamta G Pawar **[6] In** this paper model has been design in modeling software and analysis in ANSYS software. Stress and total deformation are obtained for sintered iron friction materials and associated to analysis software result. The stress using Kevlar and sintered iron is near about same. But torque transmission efficiency of sintered clutch plate more than Kevlar. Total deformation of Kevlar is less than sintered iron.

Design Evaluation of multiplate clutch by Guguloth Ravi, Thurai Sharat **[7]** In this thesis, we are using composite materials for friction surface. A 3d model is created in modeling software creo. Structural analysis, model and fatigue analysis is thru by with properties of three materials. Cast iron, Cork, asbestos comparison is done by detecting static analysis result. The stress valve for all materials are less than that of their separate yield stress valve and observing model and fatigue analysis the deformation less cast iron and fatigue analysis cast iron life is more but the damage is

ISSN: 2455-9679
Impact Factor: 3.340

more for cork and asbestos. So, concluded that using cork for friction plate is good.

Static and dynamic analysis of single clutch is four-wheeler application using ansys by P. Viswabharathy, G. Vigneshwar **[8]** In this project, current used material for clutch alloy steel. It is replaced with grey cast iron, aluminum alloy, silicon carbide, Kevlar 49, E glass epoxy. Static and dynamic analysis is done and comparison the result aluminum alloy 360 is better.

III. METHODOLOGY

3.1 Design consideration

There are two theory are used for the analysis.

1- Uniform pressure theory
2- Uniform wear theory

3.2 Selection of materials

There are many kinds of materials used for clutch plates.

1-kevlar 2-Sintered iron 3- Nickel 4-Sf001

3.2.1 Kevlar is a Friction Material:

-Kevlar is a heat-resistant and durable synthetic fiber, associated to additional aramids for example Nomex and Technora. Established by Stephanie Kwolek at DuPont in 1965, this high-quality material was utilized first financially in the mid-1970s as a substituting for steel in racing tires. Commonly it is twisted into ropes or texture sheets that can be utilized thusly or as a constituent in composite material parts.

3.2.2 Sintered Iron is a Friction Materials:

-Sintered metal is a strong item made through the procedure of powder metallurgy from various sorts of metals and amalgams. The strong metal powder parts are framed by squeezing metal powder into an intelligent mass without warming the metal to its dissolving point. Metal powder can be framed from strong metal bars or stock shapes utilizing various procedures, for example grinding, chemical decomposition, atomization and centrifugal disintegration.

3.2.3 Nickel is a Friction Materials: -

Nickel is a compound component with the representation Ni and nuclear number 28. It is a shining white glossy metal with a slight golden tinge. Nickel has a place with the progress metals and is solid and pliable. unpolluted nickel, powdered to boost the receptive surface zone, shows a critical substance movement, yet bigger parts are delayed to respond with air under standard conditions on the grounds that an oxide layer frames on a superficial level and inhibits further consumption (passivation). All things being equal, pure local nickel is found in Earth's covering just in little sums, as a rule in ultramafic rocks, and in the insides of bigger nickel–iron shooting stars that were not presented to oxygen when outside Earth's climate.

3.2.4 SF001 is a Friction Materials: -

SF001 is a Sintered friction material, appropriate for usage in Intermediate Friction applications in an extensive variation of apparatuses.

ISSN: 2455-9679
Impact Factor: 3.340

Features

- Brilliant dimensional constancy
- Brilliant Disappear resistance
- Admirable Retrieval

3.3 Engineering data

Table 1. Mechanical Properties of Friction Materials

MECHANICAL PROPERTIES	*KEVLAR*	*SINTERED IRON*	*NICKEL*	*SF001*
Young's modulus (Mpa)	154000	275.79	220000	7000
Poisson's ratio	0.36	0.34	0.30	0.5
Yield stress (MPa)	370	205	110	68
Co-efficient of friction	0.5	0.25	0.9	0.5
Density (kg/m3)	1439.5	6200	8908	1350

IV. PROBLEM DEFINITION

The main reason for the failure of clutch plates is a loss of friction material from plates, it causes less power transmission and slipping of plates. Loss of frictional material is caused because of driving a bike/car in half clutch which causes small frictional material to get lost from binding material on the clutch plate. The company has been receiving many complaints about clutch Burst Disc and Damaged Pressure Plate which resulted from an unwonted amount of clutch slippage/heat.

V. CONCLUSION

In this project, a part model of multiplate clutch has been designed in creo parametric software. Structural analysis on the clutch plate has been analyzed in ANSYS workbench 19.2 for Kevlar, Sintered Iron, Nickel, and Sf001 as friction lining materials. Ultimately, from this examination it very well may be presumed that, on the basis strength, NICKEL is more convenient and quite preferable friction material than Kevlar, Sintered Iron, Nickel, and Sf001 for the same rated torque.

REFERENCES

[1] Anil Jadhav, "***static structural analysis of multiplate clutch with friction materials***", International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 11, November – 2013

[2] Annirudha Joshi, "***Modelling and Analysis of Multi-Plate Clutch***", Volume 5 Issue 7, July 2016.

ISSN: 2455-9679
Impact Factor: 3.340

[3] Seyoum Kebede, "***Modeling, and FEA of Multi-Plate Clutches by Varying Materials for Optimum Torque Transfer Capacity of TCT System of Green, And Light Vehicles***", Vol-5, Issue-1, Jan- 2018

[4] K.N.D. Malleswara Rao**,** "***Optimal design and analysis of multi friction plates using creo and fea package***", December 2015

[5] Vishal J. Deshbharata, "***Design and Structural Analysis of Single Plate Friction Clutch***", Vol. 2 Issue 10, October – 2013

[6] G. Vigneshwar, "***Static and Dynamic Analysis of Single Plate Clutch in Four Wheeler Application Using ANSYS***", Volume 5, Issue 3, March (2017)

[7] M. Venugopal Naidu, "***Structural and thermal analysis of single plate friction clutch with different materials***", Volume 4, Issue 7, July-2018

[8] Gowtham Modally, "***Clutch assembly modeling and dynamic analysis***", Volume- 3, Issue-11, Nov.-2015

[9] Mr. Monarch K., "***Design and Analysis of Clutch Using Sintered Iron as a Friction Material''***, IJITEE, Volume-3, Issue-7, December 2013

[10] Mr. P. Naga Karna, ***"Analysis of Friction Clutch plate using FEA",*** IJERD, Volume 6, Issue 2, March 2013

[11] Mr. B. Nivas, "***Design and Analysis of Clutch Plate Using Steel Material*** [En –Gjs-400 -15steel]", IOSR-JDMS, Volume 13, Issue 5, May. 2014

[12] Pandya and Shah; 2005; ***Machine Design***; Charotar.

[13] R.S. Khurmi; J.K. Gupta; 2005; ***''Theory of Machines***; New Edition S. Chand."

[14] S. Gouse seema begum, "***Design and Analysis of Friction Clutch Plate using Ansys***", International Journal of Advanced Engineering Research and Science (IJAERS), Vol2, pp-1-5 Issue-5, May-2015