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REVIEW ON SELECTION CRITERIA FOR DIFFRENT TYPES OF CLUTCH MATERIAL

Vijay Kumar Patel[1], Gopal Sahu[2], prakash Kumar Sen[3]

[1]Student, [2,3] Lecturer, Mechanical Engineering,
Kirodimal Institute of Technology, Raigarh (C.G.)

ABSTRACT

Wear is a process of gradual removal of a material from surfaces of solids subject to contact and sliding. Damages of contact surfaces are results of wear. A Clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. A common and well known application for the clutch is in automotive vehicles where it is used to connect the engine and the gearbox. In clutch friction plate plays very important role in torque transmission from engine to transmission system. So the friction material property is very important in clutch. Due to friction between mating part some part of friction material get wear out. Torque transmission capacity of sintered-iron friction material is high and Sintered-iron material can sustain higher temperature. But ultimately, carbon-con tained grey cast iron is the ideal solution for a racing clutch friction material.

I. INTRODUCTION

The clutch is a very important machine element which plays a main role in the transmission of power from one component (driving part of machinery) to another (driven part of machinery). It is usually placed between the driving motor and the input shaft to a machine, permitting the engine to be started in an unloaded state. It is commonly used in automotive vehicles where it is used to connect the engine and the gearbox through an interruptible connection between two rotating shafts. A commonly known application of clutch is in automotive vehicles where it is used to create engagement and Disengagement between engine and the gear box for smooth performance of vehicle. Here the clutch enables to crank and start the engine disengaging the transmission and change the gear to alter the torque on the wheels. Clutches are also used extensively in production machinery of all types. Clutches allow a high inertia load to be stated with a small power.

The main agenda of this paper is the to analyze the clutch plate and the specification of the material that may be used for making the clutch plate.

II. CLUTCH MATERIAL SPECIFICATION

It is the friction pads or facings which actually transmit the power from the fly wheel to hub in the clutch plate and from there to the output shaft. There are grooves in both sides of the friction-disc facings. These grooves prevent the facings from sticking to the flywheel face and pressure plate when the clutch is disengaged. The grooves break any vacuum that might form and cause the facings to stick to the flywheel or pressure plate. The facings on many friction discs are made of cotton and asbestos fibres woven or moulded together and

impregnated with resins or other binding agents. In many friction discs, copper wires are woven or pressed into the facings to give them added strength. However, asbestos is being replaced with other materials in many clutches. Some friction discs have ceramic-metallic facings.

III. COMMANLY USED CLUTCH MATERIAL'S

After gear shift & during the clutch re-engagement the clutch disc allows the transmission of progressive torque through its Axial Stiffness. At that time wear or failure occurs in the friction plate. The different materials have different properties to resist wear and failure in the clutch plate. The different types of material that may be used for the making the clutch may be are Grey cast iron, A1-MMC (aluminium-metal matrix composite), carbon composites, ceramic based composites. The material which is used in this pressure plate is grey cast iron (FG300). The property of grey cast iron has high hardness, low tensile strength, no ductility and it can be easily machined. We analyzed this material to obtain the stress in the pressure plate. After obtaining the values, we use different materials but with suitable properties to obtain a better stress and functions of pressure plate. Hence, we use steel En GJS-400-15 as optional material to grey cast iron. These materials also have similar properties of grey cast iron. We analyze these two materials to obtain the stress in the materials. Then, we compare the stress values of all materials and take out the best. The advantage of this project is to reduce the cost of clutch plate without affecting the function and life of clutch plate. Some clutch plate material and their specification are given in the given table.

Table 1: Properties of common clutch plate lining material

Friction material against steel or CI	Dynamic co-efficient of friction		Maximum Pressure KPa	Maximum Temperature ^{0}C
	Dry	In oil		
MOLDEN	.25-.45	0.06-0.09	1030-2070	204-260
Woven	.25-.45	0.08-0.10	345-690	204-260
Sintered Material	.15-.45	0.05-0.08	1030-2070	232-677
Cast iron of hard steel	.15-.45	0.03-0.06	690-720	260

Commonly Used clutch material & there Specification- The clutch disc is generally made from grey cast iron (Afferent et al. 2003; Poser et al. 2005). This is because grey cast iron has a good wear resistance with high thermal conductivity and the production cost is low compare to other clutch disc materials such as A1-MMC (aluminium-metal matrix composite), carbon composites and ceramic based composites (Terhech et al. 1995; Jang et al. 2003). High thermal conductivity of diffusivity of the material is considered advantageous because heat is then allowed to dissipate at higher rate (Bostwick and Szadkowski 1998).

Table 2. Material Properties of Gray Cast Iron

Young's modulus	120Pa
Poisson's ratio	.29
Density	7200kg/m^3
Tensile Strength	220MPa
Share modulus	44-54GPa
Thermal conductivity	310W/m.K
Specific Heat	450J/Kg.K

Friction pads are manufactured by sintering blend of powders consisting of heat absorption material along with friction generating & lubricating materials. The powders are blended in optimized proportions & compacted to form a solid flat button of predetermined shape. The quality of materials used along with the sintering parameter play an important role in providing the required performance.

Table 3. Material Properties of sintered iron

Young's modulus	275.79Pa
Poisson's ratio	.34
Density	6.2gm/cm^3
Thermal Expansion	0.2/^{0}c
Thermal conductivity	220W/m.K
Specific Heat	50J/Kg.K

Pressure plate is made up of Grey cast iron material (FG 300) which is woven with solid centre. It has ten splines on hub which is linked with shaft. Maximum deformation in mm (pressure plate) After analyzing the materials, we found out von misses stress in MPa (overall component) that the suitability of EN GJS-400-15 steel for the production of clutch plate is better than Grey Cast Iron (FG300). En 15 steel reduces the Stress on the support link better than cast iron.

Method of Analysis-

There is number of method for analysis of wear and tear in clutch plate .The torque that can be transmitted by a clutch is a function of its geometry & the magnitude of the actuating force applied as well the condition of contact prevailing between the members. The applied force can keep the members together with a uniform pressure all over its contact area & the consequent analysis is based on uniform pressure condition. However as the time progresses some wear takes place between the contacting members & this may alter or vary the contact pressure appropriately and uniform pressure condition may no longer prevail. Hence the analysis here is based on uniform wear condition we refer PIN-ON-DISK TEST METHOD for our analysis. This method is briefly described below.

IV. PIN-ON-DISK TEST METHOD-

The pin-on-disk test is generally used as a comparative test in which controlled wear is performed on the samples to study. The volume lost allows calculating the wear rate of the material. Since the action performed on all samples is identical, the wear rate can be used as a quantitative comparative value for wear resistance.

Principle of pin-on-disk measurement: A flat indenter is loaded on to the test sample with a precisely known force. The indenter (a pin) is mounted on a stiff lever. As the disk is rotated, resulting frictional forces acting between the pin and the disk are measured by very small deflections of the arm using a strain gage sensor.

Wear Coefficients for both the pin and sample are calculated from the volume of material lost during a specific friction run.

This simple method facilitates the determination and study of friction and wear behaviour of almost every solid state material combination, with varying time, contact pressure, velocity, temperature, humidity, lubrication, etc.

This method is based on following principle:

1. Archard's equation: The Archard wear equation is a simple model used to describe sliding wear and is based around the theory of asperity contact. It concludes that the volume of the removed debris due to wear is proportional to the work done by friction forces.

Where: Q is the total volume of wear debris produced K is a dimensionless constant W is the total normal load L is the sliding distance H is the hardness of the softest contacting surfaces WL is proportional to the work done by the friction forces as described by Reye's hypothesis.

2. Amonton's First Law: The force of friction is directly proportional to the applied load.

F_f is directly proportional to N

Where N is Normal load

3. Amontons' Second Law: The force of friction is independent of the apparent area of contact. 4. Coulomb's Law of Friction: Kinetic friction is independent of the sliding velocity.

4. Euler's law: the buckling of pin is related to how much axial load is applied: Axial force on pin causing the pin to buckle = (Pin material modulus of elasticity * Pin Dia. 4) / Pin Length 2 [2]

V. TEST PROCEDURE AND CONDITIONS

The instrument base is first levelled in the horizontal position by screwing or unscrewing the adjustable rubber pads at each corner. A ball-holder containing a 3 or 6 mm diameter ball is held in the load arm and placed at a height that allow the tribo meter arm to be levelled horizontally when resting on the sample to ensure that normal load will be applied vertically.

The arm is then balanced with counter weights to ensure that the arm and ball holder initially apply no force on the sample surface. Finally, weights corresponding to the load required for the test are finely placed on the arm over the ball holder. Through software, the test is then launched and the test is performed at a specified speed for a specified duration, and the frictional force is recorded over time. The test parameters are load, duration of test, rotational rate, radius of track.

VI. FUTURE ENHANCEMENT

As far as we are concerned this topic is going to be upgraded every year and to do that we have to take out different and effective methods to test the materials. Many other techniques are already been invented but yet many techniques are yet to be unfolded. Methods can be changed by the heating treatment of different materials. More strength materials can be found in future.

RESULT-

The friction force produced by the clutch pressure plate should be directly proportional to the Normal load in thus maximum deformation in mm (pressure plate) After analyzing the materials, we found out von misses stress in MPa (overall component) that the suitability of EN GJS-400-15 steel for the production of clutch plate is better than Grey Cast Iron (FG300).

VII. CONCLUSION

Aim of our paper is study the wearing affect on different material which can be used as a clutch material. And findout the wearing effect with respect to time, speed and load. And from the basis of calculation find out the most suitable material among the materials that we are using in this experiment. In clutch friction plate plays very important role in torque transmission from engine to transmission system. So the friction material property is very important in clutch. Due to friction between mating part some part of friction material get wear out. Torque transmission capacity of sintered-iron friction material is high and Sintered-iron material can sustain higher temperature. But ultimately, carbon-contained grey cast iron is the ideal solution for a racing clutch friction material. Unfortunately its high cost makes it inaccessible to most racers. Manufacturers are working to produce cheaper varieties of the material, and no doubt these will filter down from the upper reaches of the sport over time. Until then, however, other clutch manufacturers will continue to improve the performance of their organic and metallic compounds.

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