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WEAR ANALYSIS OF CLUTCH MATERIAL

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ABSTRACT

A clutch is a very important machine element which plays a main role in the transmission of power from one component to another. A common and well known application for the clutch is in automotive vehicles where it is used to connect the engine and the gearbox. As the clutch is working condition it undergoes the affect of friction force and heating of surface and as a result wear takes place, which reduces the life of clutch.

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.

The objective is to calculate the coefficient of friction and total wear with respect to the variable (time, load and velocity) by the help of pin on Disc method to evaluate the property of the materials for the comparative study of them. To select the best material from the materials going to use in this test or enhance the properties of them to increase the life of clutch.

KEYWORDS:.Clutch Material.

INTRODUCTION

A clutch is a very important machine element which plays a main role in the transmission of power from one component (the driving part of the machine) to another (the driven part). A common and well known application for the clutch is in automotive vehicles where it is used to connect the engine and the gearbox. A clutch thus provides an interruptible connection between two rotating shafts .Clutches allow a high inertia load to be stated with a small power. A popularly known application of clutch is in automotive vehicles where it is used to connect the engine and the gear box. Here the clutch enables to crank and start the engine disengaging the transmission Disengage the transmission and change the gear to alter the torque on the wheels. Clutches are also used extensively in production machinery of all types.

Aim of our paper is study the wearing affect on different material which can be used as a clutch material. And find out 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.

METHODOLOGY

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.

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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 behavior 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.

$$Q = \frac{KWL}{H}$$

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

$$\propto \qquad F_f \qquad N$$

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.

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}

FEATURES AND SPECIFICATIONS

Parameter	**Unit**	**Min**	**Max**
Adjustable weight	Kg	1	10
Pin Size	Mm	3	12
Ball Diameter	Mm	10	12.7
Disc Size	Mm	165 x 8 mm Thick	
Sliding Speed	M/s	0.05	10
Disc Rotation	RPM	200	2000

Normal Load	N	0	200
Frictional Force	N	0	200
Wear	Mm	0	2
Track Radius	Mm	to be set manually	

TEST PROCEDURE AND CONDITIONS
The instrument base is first leveled 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 tribometer arm to be leveled 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.

APPLICATION
Fundamental wear studies, Wear map ping and PV diagrams, Friction and wear testing of metals, ceramics, soft and hard coatings, plastics, polymers and composites, lubricants, cutting fluids, heat processed samples.

RESULTS
This section includes the following results:

- Numerical results of wear rate and coefficient of friction values

- Graphs of coefficient of friction over time

The value of coefficient of friction with respect to time, load and velocity for all materials in numerous value and graphical value for comparative study of all materials for selecting best of them. Carbon-carbon is should be the best suitable material for clutch material because clutch material should withstand with high thermal effect and high speed and carbon carbon is most recent development in this field and able to with stand at high temperature and high speed than others.

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.

CONCLUSION

Ultimately, carbon-carbon 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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