An Experimental Investigation of Effect of Process Parameters on Wear of Semi Metallic Automotive Disc Brake Friction Material

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Abstract--- An Experimental wear measurement Test Rig was designed and constructed using readily available materials. The test set up was designed to test automobile disc brake pad wear and effectiveness at various pressure speed inertia load . To determine its functionality a wear test was conducted on a commercial brake pad at various pressure speeds and inertia load. This prototype test rig can be used in testing the brake pad of different vehicle such as Maruti, Tata, Nissan, Toyota, Mitsubishi, Volvo, Peugeot, and other brands of interest. With little modification, this product can be commercialized.

Keywords: Wear, Pressure, Speed, Inertia load Test Rig, Semi metallic disc brake pad.

I. INTRODUCTION

In the development of friction materials, several types of testing machines were developed, which were aimed at making brake systems safe, predictable in performance and reliable in service (Smales, 1995)[9]. Some of these machines include a variety of laboratory-scale testing machines ranging from massive inertial dynamometer with electronic controls and sensors to small rub-shoe machines that can sit on a bench top. Others are Gould recording instruments, Euro type test equipment, FAST(Friction Assessment and Screening Test) machine, Chase machine, etc (Blau, 2001)**[1]**.

However the above types of equipment are very costly and scarce in developing countries such as ours, hence the need to develop an affordable test machine with high local content arises. This work focuses on the development of experimental brake pad test rig equipment as a means of determining the performance and quality of an automotive brake friction material pad. The brake system pad wear, effectiveness at various speed ,braking forces that features low capital expenditure testing and shorter test time . Friction and wear data from pairs under various Pressure speed and load conditions will be compared and discussed. The materials used semi metallic disc pads against vented rotor.The major aim of this project is to develop an experimental brake pad test rig. This equipment will then be used to

- Investigate the effect of speed and contact pressure on the wear rate of semi metallic disc brake automotive brake pad materials.
- Investigate the average stopping time and hence the effectiveness of the brake pad material at different Speed.

II. LIMITATION OF THE TEST RIG

Blau, P.J (2001) noted that the brake performance is affected not only by its materials and vehicle hard ware design but also significantly by

- The driver's behavior and vehicle usage.
- The state of adjustment of the brake hardware.
- The overall environment in which the vehicle is driven.
- Possible influences of braking control systems.
- Aerodynamics in the wheels.

III. METHODOLOGY

This section describes the materials and methods used for the processing of the composites under this investigation. Here experimental setup, process and response parameters, and their measuring method discussed in detail. The methodology based on Taguchi experimental design and graphical interpretation of the wear with effect of process parameter.

A. Specification Of Material

1) *Semi-metallic lining (or resin-bonded metallic):* Semi - metallic linings typically comprise about 65 wt% total iron content, 10-25 wt% steel wool, about 15 wt% graphite and 10 wt% organic binder.

Number of process parameters that effect on wear of semi metallic brake friction material for their various response. The experimentation work on semi metallic disc brake pad material have been decided on our developed set up .

Symbol	Process parameters	Unit	Level 1	Level 2	Level 3
A	PRESSURE	bar	1.5	2.5	3.5
B	SPEED	rpm	180	300	450
C	INERTIA WEIGHT	kg	20	30	50

Table. 1: Parameter selection and their levels.

Fig. 1: Experimental setup

For the present experimental study semi metallic disc brake friction material is used and inertia type dynamometer has been used to measure the wear.

To design the experiment of the present study, taguchi mixed level L9 orthogonal array has been used and L9orthogonal array has been selected for experiment design

IV. Result And Discussion

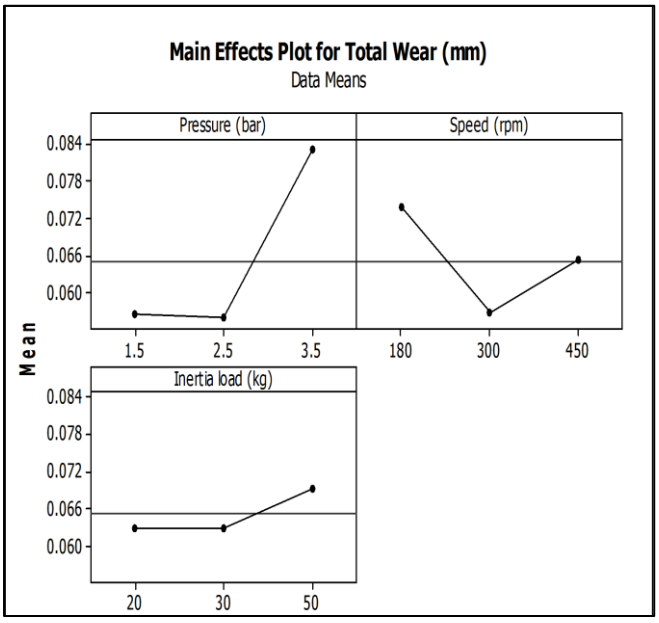

Fig. 2: Main effect plot of wear

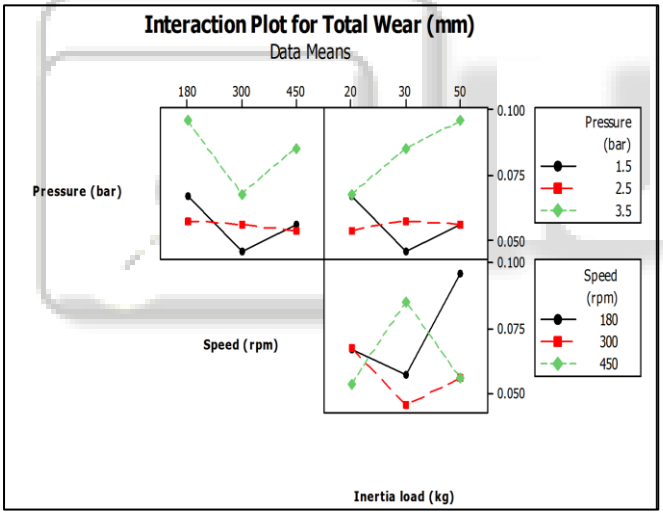

Fig. 3: Interaction plot of total wear

1) Influence of pressure on wear

Figure 2 show that influence of variation in inertia on wear of semi metallic disc brake friction material at various combination levels of speed ,load. It has been observed that wear decreased initially with 1.5 bar pressure from 2.5 bar and then 3.5 bar wear is increasing.

2) Influence of speed on wear

Figure 2 show that effect of variation in speed on wear of semi metallic disc brake friction material observed during various combination level of load pressure. The speed increased with decreasing wear180 rpm to 300 rpm and then start increasing to 450 rpm.

3) Influence of inertia load on wear

Figure 2 show that the influence of the variation inertia load on wear of semi metallic disc brake friction material at various combination levels of speed ,pressure. wear increasing with increasing in inertia load.

V. Conclusions

Based on experiments conducted during present course of work, using our wear measuring test rig set up for studying wear of semi metallic disc brake friction material with effect of pressure ,speed and inertia load following conclusion are derived.

- As the pressure increases wear of semi metallic disc brake friction material is increases.
- The speed increased with decreasing wear180 rpm to 300 rpm and then starts increasing to 450 rpm.
- Variation inertia load on wear of semi metallic disc brake friction material at various combination levels of speed, pressure. Wear increasing with increasing in inertia load.

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