Investigation of the Test Device Determining Characteristics of Automotive Brake Pads

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Abstract

To learn about the coefficient of friction of the brake disk and the tribological properties of the materials to learn the various test devices have been developed. Friction and wear resistance test method used to measure the number of models to be the cause of much friction and wear mechanisms and tribological system is because of the over. For this reason, large part of the studies of friction and wear at present are done by using determined by the international standard test specifications and parameters. In the design used in friction materials, the most important factor of friction event is coefficient of friction and wear. Basic properties requested of a brake pad are suitable to the standards of corrosion resistance, friction coefficient and economical. These features in determining the precise hardware with automatic control unit and the importance of testing equipment is quite significant. Earlier studies that are conducted to learn about and considering the coefficient of friction of the brake discs to find the tribological properties of the materials, various testing devices have been developed. In our country and in developed countries it is possible to show examples of this work. In this study , a number of research studies have been conducted to examine automobile brake pads used in determining the characteristics of the test equipment used for the purpose for what and contribution to Turkey industry.

Key words: *Test device, Tribology, Design, Coefficient of friction*

1. Introduction

Nowadays, several industrial companies are interested in R&D activities to improve the efficiency performance of the friction material [1,3]. When the roughness decreased hard and shiny surfaces can be obtain which means the sliding surface is caused slide more easily over one another. Therefore, new pads are being passed through some tests such as crushing, shear, abrasion, and heat and water resistance at the stage of their construction. The negative reasons described above are intended to reduce to a minimum the pads of the potential adverse effects occur while driving [3]. The brake pads wear out as a result of friction of the brake disc and the pad and there have been substantial research efforts to prevent this matter. The performance of the brake pads has been increased as a result of tribology experiments. A number of test equipments have been designed and built to investigate different wear types. One of the most important mechanisms in the automobiles is the brake system since the life safety of the people is relying on these systems. A car should stop in the shortest distance when the driver press down the brake and thus this is related with the coefficient of friction. A number of test equipments have been developed to explore the coefficient of friction and tribological features of the materials of the brake pads.

2. Materials and Method

There are principles in product design. Good designers develop techniques that help them to implement these principles. There is a process for design: it starts from a place and there are steps to follow. This process of getting design right is applicable in most design contexts. Although some steps may be skipped, the basic process is sound.

Ertas and Jones [4] define “design process” as “...begins with an identified need and concludes with satisfactory qualification and acceptance testing of the prototype”.

Voland [5] uses the term “the engineering design process” and composes this process into five stages; 1) need assessment, 2) problem formulation, 3) abstraction and synthesis, 4) analysis, and 5) implementation.

In the development of the test devise Volland’s design method has been followed. The outcome has been found a successful product design.

3. Testing Device Used for Testing Brake Pads Used in Automobiles

Hilmi Kuşçu and Mustafa Timur designed and built the ‘Testing device used for testing friction coefficient of brake pads used in automobiles’.

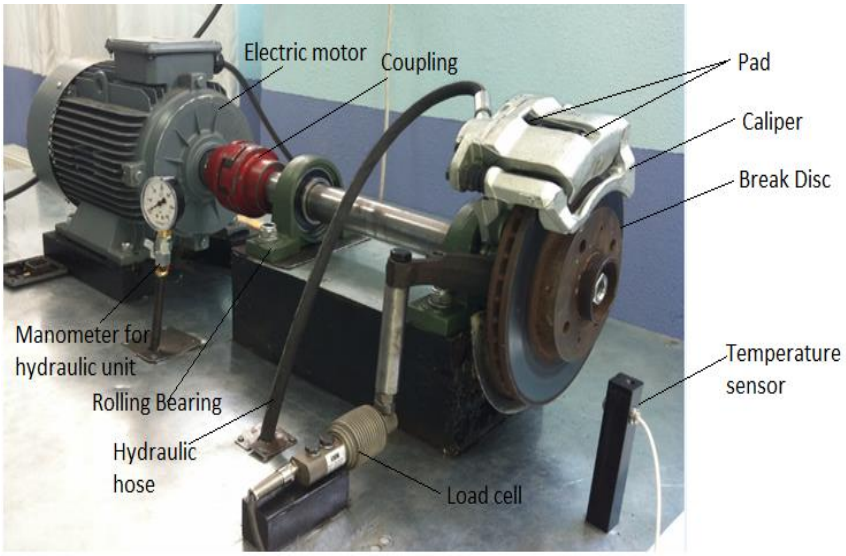

Figure 1 The testing device used for testing brake pads used in automobiles

The test device is shown in;**Hata! Başvuru kaynağı bulunamadı.** is designed as it gives reliable results according to the experimental standards. It has been paid particular attention on the detail of design and manufacture of the test device in order to run experiments in a convenient way. Coefficient of friction of the brake pads can be examined under different factors including different speed, temperature, pressure etc. The device can produce graphs for Coefficient of friction- Temperature, Coefficient of friction- Time, Temperature- Time. In order to spin the brake disc in the experiment set-up an electric motor with the power 7,5 KW and 1400 RPM/min is been used. The speed of disk is 6 m/s is obtained by 1400 RPM/min.

The first step considered in the manufacture of the test device is to design of the mechanic part of the brake system in a vehicle. The parts that are used in the device including a disc, an electric motor in order to spin the disc, a caliper and pad for sheet metal in order to place brake pad on the caliper. The mechanic system of the test device is placed on the table. The second step considered in order to braking in the mechanic part, the pressure generating the pedal load is controlled by the hydraulic unit. The hydraulic unit is placed under the table. A number of experiments were performed to validate the results of the test device and its reproducibility. The results obtained from the test devise is given in [1].

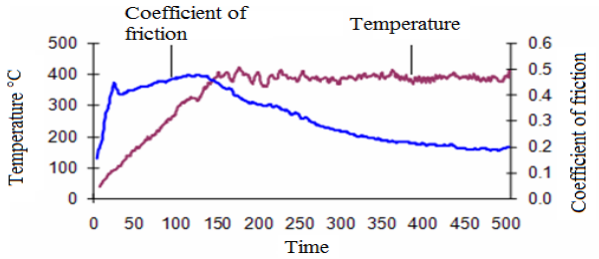

Figure 2 A Graph of Friction material's Temperature - Friction Coefficient - Time

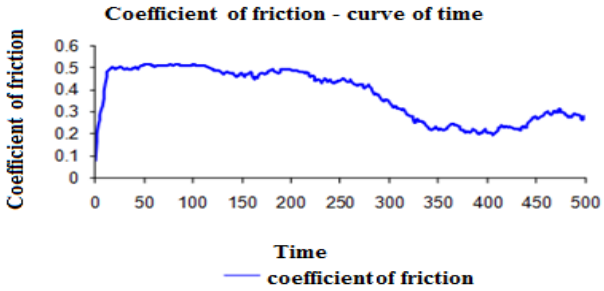

Figure 3 A graph of Friction Material's Friction Coefficient –Time

İbrahim Mutlu and Recep Koç designed and built a 'Test device used for testing friction coefficient of brake pads used in automobiles'. The values in the device can be perceived as desired interval and saved them on computer. The device can produce graphs for Coefficient of friction- Temperature, Coefficient of friction- Time and Temperature- Time. Speed change and pressure can be adjusted by manually. Figure 4 shows the test device in a schematic way [2].

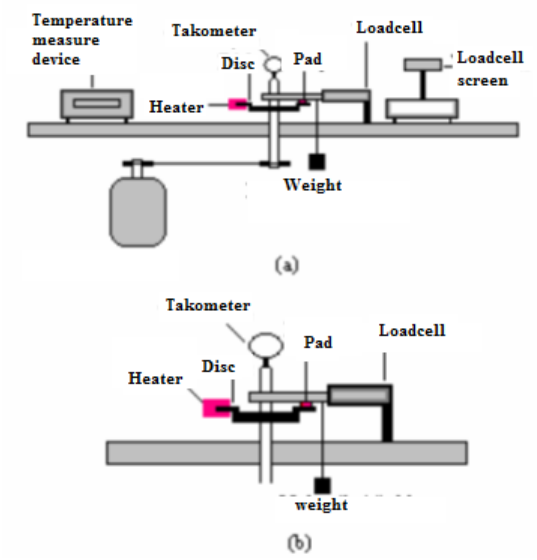

Figure 4 Experimental set-up

The methodology developed at the surface engineering Labratory in NJIT by R. Dubrovsky and A. Titov is consist of variety of research techniques in terms of quality and quantity of analysis experiments results. These methods are included in assessment of friction coefficient an wear rate [6].

Wear test device is built by Y.Karaoğlu and O. Eldoğan is another example work which investigate the tribologic features of brake pads. The purpose of this project is the same as the first example work. Figure 5 shows the general view of the wear test device. In this device, a brake discs is used in the current cars. Hydraulic pressure is applied from the both surfaces of the disc. Experimental works is managed from a computer [8].

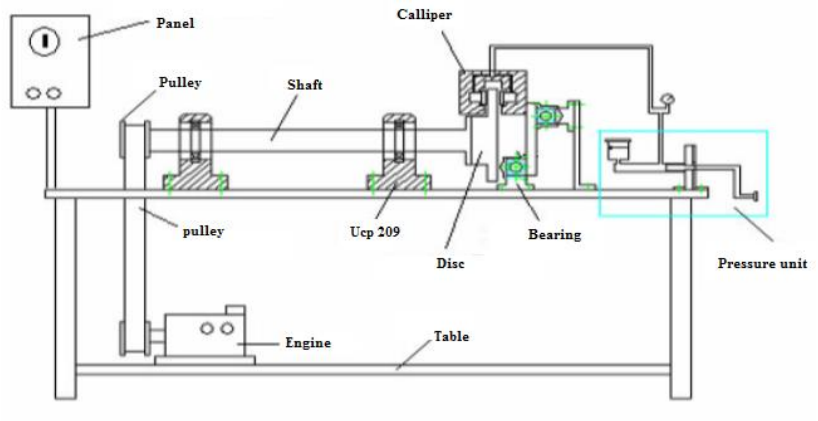

Figure 5 General view of the wear test device

M. Demiral and M. Yaşar designed and built a tribotest test device with pin-disc system which examines wear and friction of the Aluminum bronze. An AC electric motor with the power 1,5KW and 1500 RPM/min is been used. A speed adjuster device has been used to adjust the slip rate. Figure 6 shows the top view of the tribotest device [9].

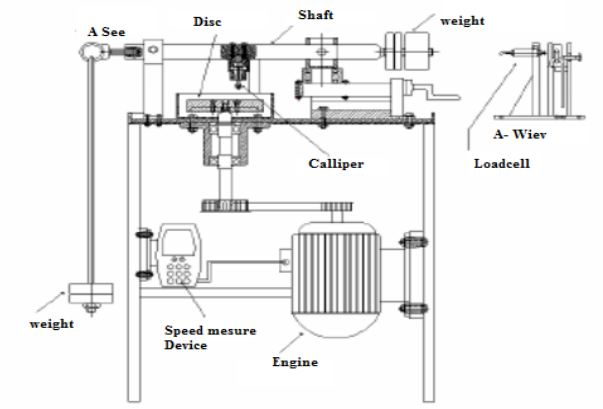

Figure 6 Tribotest device

Figure 7 shows the test device is made by Michael Ericsson and his friends that the purpose of the devise is to test the friction coefficient of friction materials. The device is made in 2002 at the University of Cambridge. The main difference of this device from others is a torque meter is been used. In this way, the obtained data under which torque is been able to examined and relevant graphics can be produced.

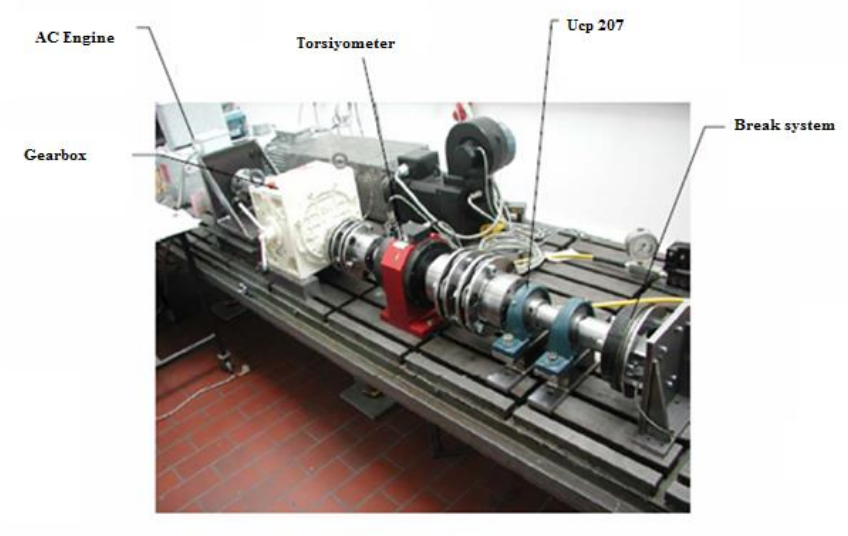

Figure 7 A test device is made by Michael Ericsson and his friends [10]

Figure 8 shows different type of friction coefficient test device. The quality control test procedure is been made according to SAE J661 standards. The equipment on the friction materials of friction coefficient provides accurate data. The devise is controlled by a computer and the results are given in graphics.

Figure 8 The test device is made by Chase Machine [1]

Figure 9 shows the test device works based on Reciprocator (shuttling) that moves linearly. An inverter is controlling the electric motor in the device and the computer is controlling slip rate. Normal load and Friction force is being measure by a loadceller the computer programme evaluates these forces and produces graphics as Coefficient of friction-Time or Way. The distance-measuring sensor that amounted the device measures 10-micron accuracy. This sensor is able to measure and save the changes of the height even the experiments is running.

The systems such as roller bearing or slippers that touches each other and moves according to each other, frictions occurs so that this makes parts moves away each other. Therefore, in real systems, both faces are abraded out and pieces stay between the parts. The distance measured system used in the designed and built tribotest device is able to do suitable measurement

- Coefficient of friction- Time
- Coefficient of friction- Way
- Wear amount – Time
- Wear amount – Way
- Wear rate- Time
- Wear rate- Way
- Wear resistance –Time
- Wear resistance –Way

Graphics can be drawn automatically and saved as data.

Figure 9 The test device works based on Reciprocator (shuttling) [7]

4. Results

The more improved sensitivity and impact capability in the cars' parts mean safe drive in the automotive sector. Especially brake systems play very important role in human safety. Friction coefficient and wear resistance that have appropriate standards are very important characteristics of the brake pads. It is very important to know these characteristics and to choose suitable brake pads according to them. Therefore there is need to have accurate test devices in order to make brake pads that have desired properties.

Nowadays, it can be seen that there is a number of tests are performed on the brake pads. Tribological event between the parts have been examined with the test devices and desired information (Friction Coefficient, wear amount and friction force) is obtained.

One of the purposes of this work is to promote original designs of test devices to identify Friction Coefficient, wear amount and friction force of car pads.

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