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# Comparison of Commercial and Palm Slag Motorcycle Brake Pads Performance

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## ABSTRACT

This paper presents a number of experimental data and techniques used in performance of commercial and palm slag motorcycle brake pads. The experiments include wear and hardness tests. The wear behavior of motorcycle brake pad that was observed in the study on sliding contact member brake discs results in the conversion of kinetic energy into heat at the pad and disc interface leads to this investigation. The effects of speed of disc brake rotor are presented. Experimental results of the respective tests are presented on two motorcycle brake pads, namely commercial brake pad (CBP) and palm slag brake pad (PBP). It was found that the wear behavior of palm slag brake pad is influenced by design of geometry shape of motorcycle brake pad. The wear behavior of CBP and PBP composite depend on wet and dry condition. It is clearly seen that wear behavior of PBP composite increase significantly with dry condition. Wear behavior increase significantly with the increase of rotor speed. With increasing speed of rotor disc, the hardness of PBP composite changes from low hardness to a more stable hardness behavior.

**KEYWORDS:** *hardness, wear, motorcycle brake pad, palm slag.*

## 1.0 INTRODUCTION

The wear response of motorcycle brake pad is an essential part of basic property data required for the optimized design of motorcycle brake pad structure. Although numerous studies relating to the wear behaviors have been conducted, the mechanism of motorcycle brake pad failure in wear has not been well understood. The main effect of motorcycle brake pads performance was found to be contribution of on heat transfer coefficient, temperature, total heat, and brake pads geometry [1], [2]. Much of this understanding of motorcycle brake pads performance has been obtained on the basis of mechanical test. Relatively little work has been conducted to investigate the wear and hardness behavior of palm slag brake pad composites [3, 4,5,6,7].

In this paper, the wear and hardness behavior of commercial brake pad (CBP) and palm slag brake pad (PBP) were studied experimentally. SAE J661 test procedure was also conducted for comparison. For the wear behavior of CBP and PBP, this paper tries to compare them in aspects of the wear mechanism, failure mode and the factors influencing wear and hardness behavior. The influent factors were the speed of disc brake rotor and the design of geometry shape of motorcycle brake pad. Prediction of the performance of CBP and PBP was also analyzed based on experimental results and some analytical models.

## 2.0 EXPERIMENTAL METHOD

The test specimens used for the test are two kinds of brake pad of CBP and PBP. The configuration of the specimen is shown in Fig. 1. The palm slag brake specimens were produced with phenolic resin, steel fiber, graphite, alumina, palm slag [3].

(a) CBP (b) PBP
Figure. 1: Specimen CBP and PBP

### 2.1 Wear tests

Wear tests were performed using the disc brake rotor is shown in Fig. 2. The test was run for rotor speed of 1275 rpm, 1700 rpm, and 2150 rpm. The CBP and PBP were weighted before and after testing to determine the weight loss within accuracy 0.001 g.

We selected one kind of disc brake of motorcycle as testing machine equipment. Wear tests is done directly on the motorcycle (test drive). Products of the brake pads will be tested in wet and dry conditions. It aims to look at the performance of products in various conditions when the brake pads on the streets. Standard wear testing on a motorcycle based on ISO 4404: 2008. The principle of the test by hanging a weight of 3.6 kg on the brake pedal in order to hold the braking force constant.

The road condition must be flat and not bumpy. The system of the apparatus is shown in Fig. 2. Brake linings to be tested is mounted on the rear disc brake caliper motorcycle. Motorcycle run up to speeds of 1275 rpm, 1700 rpm, and 2150 rpm. The load on the brake pedal is released.

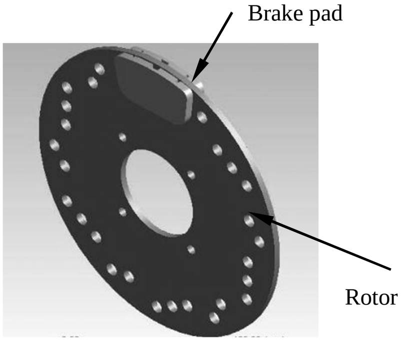


Figure 2: Brake pad and rotor disc

The braking process is not influenced by braking the secondary. When the braking process coupling must be connected and when the speed has reached 50% coupling must be removed. Braking time to be recorded until the motorcycle stopped. Wear test in wet conditions that resemble wet when it rains, water is sprayed to wet brake discs and brake pads. Wear volume and wear rate for the brake pad composites were calculated by the following Eq.1 and Eq. 2.

$$\text{Wear volume} = \frac{Wg_{before} - Wg_{after}}{\rho} \quad (1)$$

$$\text{Wear rate} = \frac{\text{Wear volume}(\text{m}^3)}{\text{Sliding distance (m)}} \quad (2)$$

### 2.2 Hardness tests

The hardness test was conducted in hardness testing machine. Hardness testing commercial brake pads and brake pads palm slag filler composite material made using the Brinell method. Indenter used in this test is a hardened steel ball with a diameter of 2.5 mm and a load of 15.625 kg emphasis. The standard test is ASTM F 1957-99. Terms of the hardness test is the distance between the point of testing with the next testing point should be at least long emphasis in 3D with 15 seconds. In the hardness test are tracking indenter diameter which is variable in determining the value of brake pads violence.

Diameter of tracking is evident in test equipment that uses microscopic systems and can be measured using a ruler with 70 x magnification. Tests conducted as many as 10 points on each product to get the value of hardness at the surface of the brake pads. Hardness test brake pads is shown in Fig. 3. Value hardness test results can be calculated with Eq. 3.

Figure. 3: Hardness testing setup

$$HB = \frac{2F}{\pi D\left[D - \sqrt{D^2 - d^2}\right]} \quad (3)$$

## 3.0 EXPERIMENTAL RESULTS AND DISCUSSIONS

### 3.1 Wear behavior

Figure 4 shows the wear behavior of CBP and PBP. It is clearly seen that wear behavior increase significantly with the increase of rotor speed. The wear behavior of CBP and PBP composite depend on wet and dry condition. It is clearly seen that wear behavior of PBP composite increase significantly with dry condition.

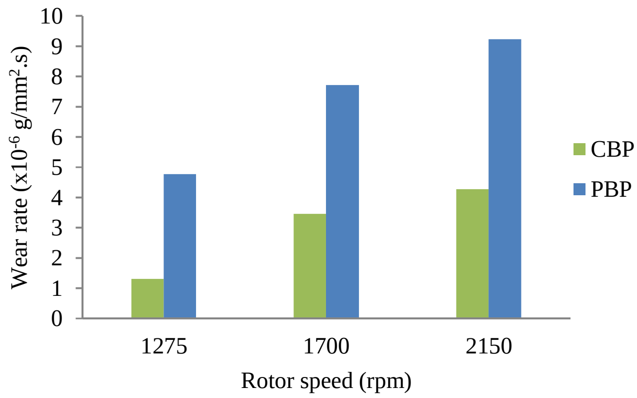


Figure 4: Wear behavior of CBP and PBP in wet condition

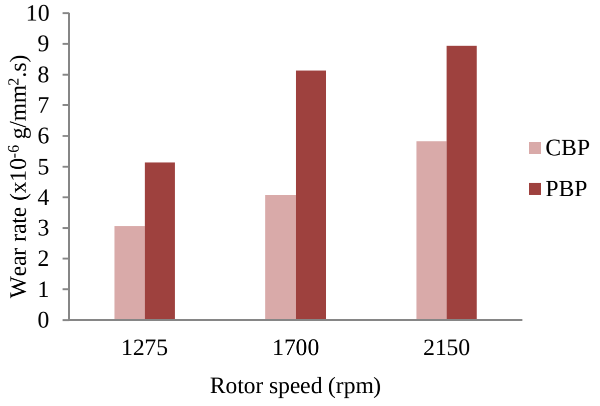


Figure 5: Wear behavior of CBP and PBP in dry condition

Figure 6 and 7 show the hardness of CBP and PBP composite. It was observed in the hardness test that the hardness of the PBP composite is the highest value. Because of steel fiber as the reinforcement of composites, hardness number of PBP increased with the increase in percentage of steel fiber weight [3]. With increasing speed of rotor disc, the hardness of PBP composite changes from low hardness to a more stable hardness behavior, see Fig 6 and 7.

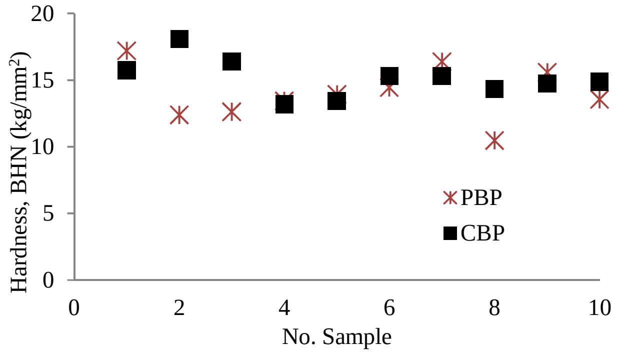


Figure 6: Hardness number of CBP and PBP in wet condition

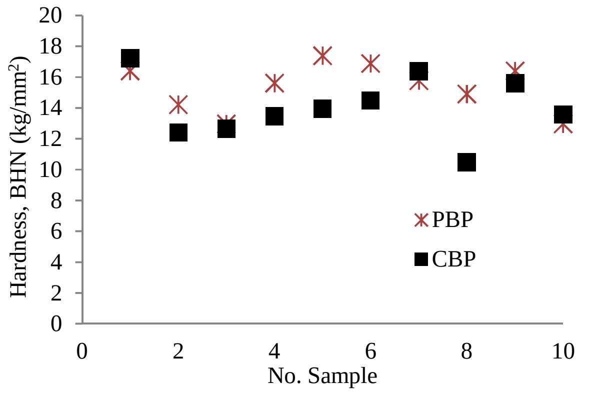


Figure 7: Hardness number of CBP and PBP in dry condition

In wet conditions the wear testing CBP has wear smaller than PBP. When viewed from a distance of braking and braking, PBP require considerable time and braking distance long enough to stop. It shows that in wet conditions experienced PBP fading. Fading happened to cause the PBP be no grip up time and the braking distance is relatively long. Fading on canvas brake influenced the composition of materials and the type of treatment received during manufacture brake pads.

When viewed as a whole from Fig. 6 and 7, CBP has a higher hardness values. While MDO approaches the canvas violence CBP. The difference is due to the violent precursor composition brake pads CBP consisting of reinforcing fibers such as steel fiber, carbon fiber, kevlar and wool. The reinforcing fibers make stronger bonds between the constituent materials and increases the density (density) on brake pads that increase violence brake pads.

## 4.0 CONCLUSIONS

The wear behaviors of CBP and PBP under disc brake rotor speed were studied experimentally. The following conclusions were drawn.

1) Wear behavior of CBP and PBP composite depend on wet and dry condition. It is clearly seen that wear behavior of PBP composite increase significantly with dry condition. Wear behavior increase significantly with the increase of rotor speed.
2) With increasing speed of rotor disc, the hardness of PBP composite changes from low hardness to a more stable hardness behavior.

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