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A Better Measure.

Brake Pad Temperature Tribology Evaluation

Prepared by

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INTRO

Brake pads are composites., material made up of multiple ingredients, that must be able to satisfy a large number of safety requirements. Ideal brake pads have high coefficient of friction (COF), low wear rate, minimal noise, and remain reliable under varying environments. To ensure the quality of brake pads are able to satisfy their requirements, tribology testing can be used to identify critical specifications.

IMPORTANCE OF EVALUATING PERFORMANCE OF BRAKE PADS

The importance on the reliability of brake pads are placed very high; safety of passengers should never be neglected. Therefore, it is key to replicate operating conditions and identify possible points of failure. With the Nanovea Tribometer, a constant load is applied between a pin, ball, or flat and a constantly moving counter material. The friction between the two material is collected with a stiff load cell, allowing collection of material properties at different loads and speeds and tested in high temperature, corrosive, or liquid environments.

MEASUREMENT OBJECTIVE

In this study, the coefficient of friction of the brake pads were studied under a continuously increasing temperature environment from room temperature to 700°C. The environmental temperature was raised in-situ until noticeable failure of the brake pad was observed. A thermocouple was attached to the backside of the pin to measure the temperature near the sliding interface.

Figure 1: Tribology test setup for High Temperature Brake Pad Tests

TEST PROCEDURE

Test parameters	Value
Normal force	20N
Rotational speed	300rpm
Duration of test	45min
Revolutions	13502
Distance traveled	847.9m
Atmosphere	Air
Temperature	24°C (room) – 700°C
Wear track radius	10mm
Pin material	SS440C
Pin diameter	6mm

Table 1: Test parameters for the brake pads COF test

RESULTS AND DISCUSSION

This study focuses mainly on the temperature at which brake pads starts to fail. The COF obtained do not represent real-life values; the pin material is not the same as brake rotors. It should also be noted that the temperature data collected is the temperature of the pin and not the sliding interface temperature.

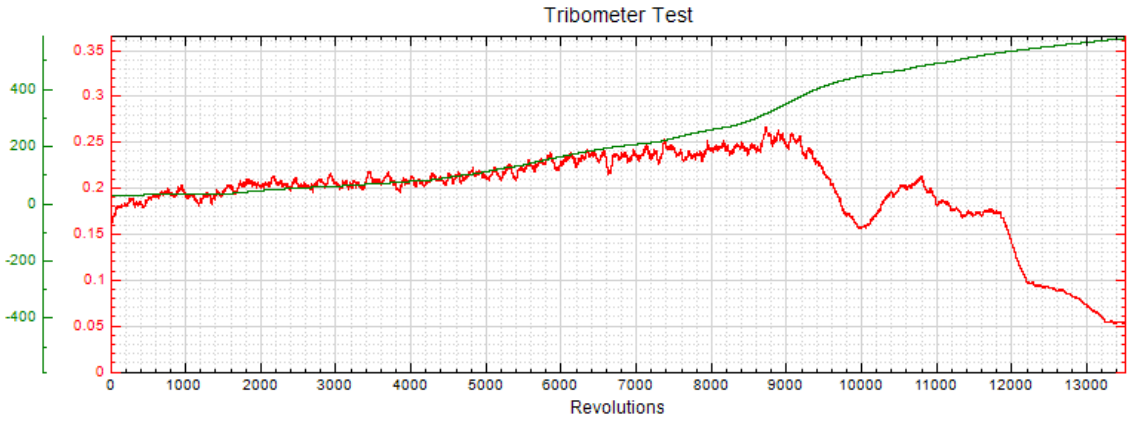

Figure 2: COF and Temperature vs Revolutions

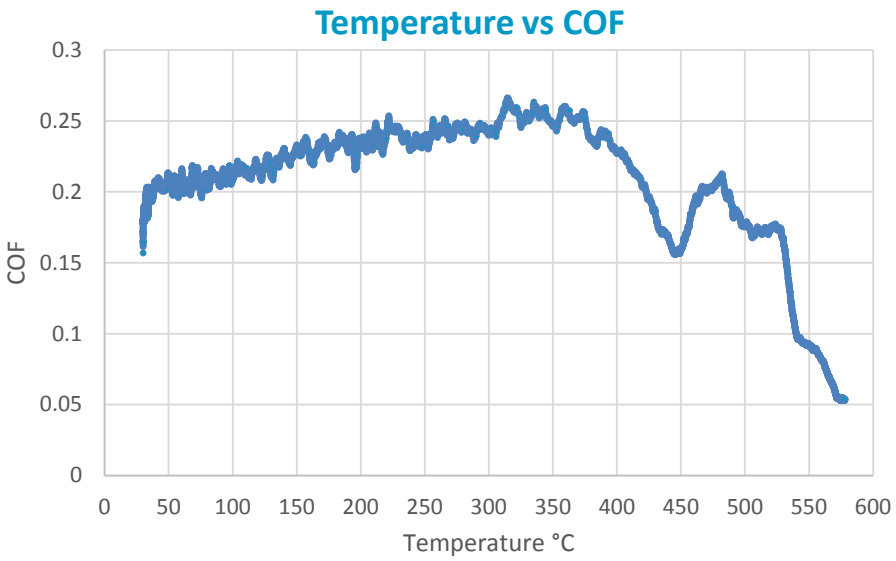

Figure 3: COF vs Temperature

At the start of the test (room temperature), the COF between the SS440C pin and brake pad gave a consistent value of approximately 0.2. As the temperature increased, the COF steadily increased and peaked at a value of 0.26 near 350°C. Past 390°C, the COF quickly starts decreasing. The COF began to increase back to 0.2 at 450°C but starts decreasing to a value of 0.05 shortly after.

The temperature at which the brake pads consistently failed is identified at temperatures above 500°C. Past this temperature, the COF was no longer able to retain the starting COF of 0.2.

CONCLUSION

The brake pads have shown consistent failure at a temperature past 500°C. Its initial temperature of 0.2 slowly rises to a value of 0.26 before dropping down to 0.05 at the end of the test (580°C). The difference between 0.05 and 0.2 is a factor of 4. This means that the normal force at 580°C must be four times greater than at room temperature to achieve the same stopping force!

While not included in this study, the Nanovea Tribometer is also able to conduct testing to observe another important property of brake pads: wear rate. By utilizing our 3D non-contact profilometers, the volume of the wear track can be obtained to calculate how quickly samples wear. Wear testing can be conducted with the Nanovea Tribometer under different test conditions and environments to best simulate operating conditions.

Learn More about the Nanovea Tribometer or Lab Services