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A study of development and performance characteristics of NAO brake linings with fly ash

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Abstract

A lot of development for finding out suitable material for brake lining composite has taken place after ban on asbestos in European Countries & USA. Though asbestos, due to excellent properties, has proven its ability to be a suitable material for brake lining still it must be replaced due to its carcinogenic nature. There had been significant number of attempts made by research community all over the world to develop alternative material for replacing asbestos. The current work is an attempt to develop & study performance characteristics of a new NAO composite for brake lining with fly ash.

Keywords: NAO, Brake Lining, Fly Ash

1. Introduction

Brake linings are the consumable surfaces in brake systems, such as drum brakes and disc brakes used in transport vehicle. Brake linings are composed of a relatively soft but tough and heat-resistant material with a high coefficient of dynamic friction and ideally an identical coefficient of static friction typically mounted to a solid metal backing using high-temperature adhesives or rivets. The complete assembly is then often called a brake pad. The dynamic friction coefficient for most standard brake pads is usually in the range of 0.35 to 0.42 since the lining is the portion of the braking system which converts the vehicle's kinetic energy into heat, the lining must be capable of surviving high temperatures without excessive wear. Due to its performance, asbestos was often a component in brake linings. Fly ash is one of the residues generated in combustion and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators. In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now require that it be captured prior to release. Before the ban on usage of asbestos in brake linings, asbestos was the most preferred filler material. Asbestos had a few engineering characteristics that made it very desirable for inclusion in brake linings. Asbestos is thermally stable up to 490-500 °C, it helps regenerate friction surface during use, it insulates thermally, it is strong and flexible and, mostly, it is available cheap. Since the ban on asbestos, researchers have struggled to come up with an equally efficient alternative. Barites, mica and cashew dust are amongst some of the materials that have been considered for use as fillers.

2. Materials and Methods

2.1 Objectives

This research work was intended to develop asbestos free brake lining having desirable performance by using materials like fly ash as a filler. The Work has studied performance of brake pads by formulation of samples in varying percentage of fly ash. This work has studied performance parameters of the brake pads viz. friction & wear characteristics, thermal stability, low fade & high recovery properties, physical stability properties.

2.2 Materials

The experiment was done by using various combinations of materials. For the experimental purpose, three samples were prepared by replacing asbestos with fly ash. The samples were prepared using wt% method to form the composites. The Samples primarily contained Fly ash, phenolic resin, graphite as a basic constituents along with copper powder, tin powder & coconut shell powder each respectively in three different samples.

2.3 Experimental Method

The various test machines which were used in the work was Pin on Disc machine. Initially, the samples were prepared by manufacturing pins required for tribological observations by using powder metallurgy method. The powders in necessary wt% were taken by measuring on digital balance, then mixed together properly & processed through powder compacting machine. The composites were pressed upto pressure of 325 MPa, which resulted into formation of well mixed & structured cylindrical pins. The composite samples were sintered upto 150 °C for 120 min. The pins were formed by

machining the composite samples to the size of 12 mm dia. for the experimental purpose. The friction & wear characteristics were studied by using Pin on Disc Tribometer. The parameters used for wear test were based on speed of vehicle & minimal weight capability by the current brake lining composite. The tests were conducted for 1200 seconds, duration of time for new brake lining composite samples.

The samples were tested by using the parameters given in the table no.1 for the friction & wear tests on Pin on Disc Tribometer

Table 1: Test Parameters

New Composites	Speed (RPM)	Weight (Newton)	Time (Seconds)	Wear track dia.(mm)
NAO1	569	49.05	1200	140
NAO2	1591	49.05	1200	50
NAO3	1593	49.05	1200	50

3. Results and Discussions

The tests were taken on Pin on disc Tribometer by putting each new composite sample pin to test for 20 min. The sliding disc was made from EN8 which is standard disc

material used for common disc brakes in two wheeler applications.

The results obtained from the friction & wear tests are given in the table no.2

Table 2: Results of Friction & Wear tests

New Composites	Weight (Newton)	Frictional Force(Newton)	Coefficient of Friction	Wear (micrometers)
NAO1	49.05	18.89	0.38	217
NAO2	49.05	20.63	0.42	62
NAO3	49.05	21.90	0.44	470

The coefficient of friction seems to vary between 0.38 to 0.44 which seems to be reaching higher side of the current commercial brake lining brake materials but still near to the commonly observed values. The wear increased initially & got steady as the formation of friction layer on the sliding surface. The wear for the material containing coconut shell powder (NAO2) as a constituent was less than other composites. The reason behind this can be homogenous binding of the molecules of NAO2 composites than the other two ones.

4. Conclusion

As per the observations obtained in the friction & wear tests, the new brake lining composites seems to be a promising composition for brake lining & may consider for light weight applications. Thus, the need for eco friendly alternative for brake lining composites can be served by further investigation into the current research work.

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