Review on Development of Composite Material for Disc Brake Pad

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Abstract— **Disc brakes are widely used for reducing velocity for their characteristics of braking stability, controllability and their ability to provide a wide ranging torques. The braking processes in the friction units of a brake are very complicated. In the course of breaking all parameters of processes like load, temperature, physicomechanical and tribological characteristics of the materials of the couple and conditions of contact vary with time. During braking both brake pad and disc surfaces worn thereby affecting the useful life of brake as well as its behavior. As per the literature survey, asbestos is widely used in automobile disc brake pads. But as a result of its carcinogenic nature it causes cancer and thus the use of asbestos should be avoided. The paper presents the study of different material compositions as well as the effect of that composition on friction & wear of brake pad.**

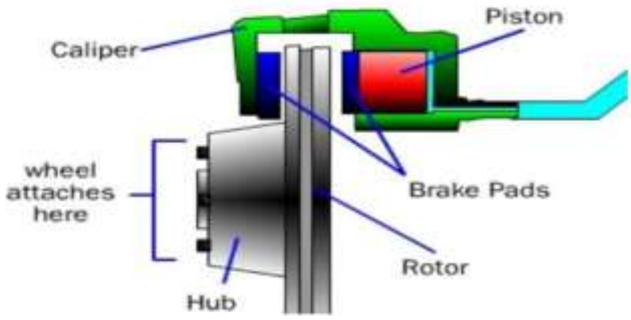
Keywords: disc brake, brake friction materials, wear rate.

1. INTRODUCTION

Generally asbestos is widely used as a fiction material for automobile disc brake pads. Brake pads are exposed to a lot of friction which generates a lot of heat. Asbestos is a better material for absorbing and dissipating heat. But when asbestos breaks down, it's creates dust that's dangerous to breathe. Furthermore its carcinogenic nature makes it more harmful to human beings. For these purpose some of the brake pads are made from safer organic materials. Organic brake pads, sometimes called non-asbestos organic brake pads, are made from natural materials liked glass and rubber, as well as resins that can withstand high heat. In fact, the high heat helps to bind the brake pad materials together. An advantage of organic brake pads, is that they're made of materials that don't pollute as they wear and they're easier to dispose of. They're also softer than brake pads made of other materials, which means that they make less noise.

1.1 Disc Brake

A disc brake system consists of a brake disc, a brake caliper and brake pads as shown in fig.3.1. When the brake pedal is applied, pressurized hydraulic fluid squeezes the brake pad friction material against the surface of the rotating brake disc. The result of this contact produces friction which enables the vehicle to slow down or stop.



Disc brakes are fairly simple to work with. Typically, there are four main parts of a disc brake system as given below:

1. Mounting Bracket
Mounting Brackets are used to hold the caliper in place. Other than keeping the surface clean and free of rust road, there is very little to bed one with this part.

2. Rotor
Rotors are metal discs supported by the suspension. The calipers clamp onto them to slow their rotation, and then slow or stop the car. Vented rotors have fins in the spaces between their machined surfaces. These spaces allow air to pass through, which helps carry heat away. Non-vented rotors are used on smaller vehicles, and have no cooling fins.

3. Caliper
Calipers are the housings that contain the pistons and the brake pads. The calipers are connected to the hydraulic system, and hold the brake pads to the rotor.
There are two types of calipers as:
a) Fixed Caliper: Applies two pistons to opposite sides of rotor. Fixed calipers are disc brakes that use a caliper, which is fixed in position and does not slide. They have pistons on both sides of the disc. There may be two or four pistons per caliper. Motorcycles and some import trucks and cars use this type. b) Sliding Caliper:-There are two pistons between which fluid under pressure is sent which passes one friction pad directly on to the disc whereas the other pad is passed in directly via caliper.

2.LITERATURE REVIEW

P. Thiyagarajan et al. [1] has introduced carbon fibers as reinforcement and graphite powder as friction modifier in the brake pad material, by his research he concluded that the brake pad material can play a vital role in this direction. The study reports the influence of these modifications on the thermal properties like coefficient of thermal expansion (CTE) and thermal conductivity along with the mechanical properties of non-asbestos brake pad composites samples developed in the laboratory. He also concluded that composition also helps in controlling the hardness of the brake pad to desired level. Reinforcement of carbon fibers at the present level does not influence the properties as much as the steel wool.
R. B. Mathur et al. [2] has formulated material with CNSL and studied tribological properties. In spite of unparalleled combination of essential material properties for brake linings and clutch facings, replacement for asbestos is seriously called for since it is a health hazard. If once asbestos is replaced with other material then composition and properties of brake pad changes. In certain cases hardness of the material may be high enough to affect the rotor material. In this study, hardness of the brake pad has been controlled using suitable reinforcement materials like glass, carbon and Kevlar pulp. Brake pad formulations were made using CNSL (cashew net shell liquid) modified phenolic resin as a binder, graphite or cashew dust as a friction modifier and barium sulphate, talc and wollastonite as fillers.
A.Saffar et al. [3] studied deeply the role of rubber component on the tribological characteristics of composite friction materials. They prepared a series of friction materials with various amounts of rubber component, ranging from completely pure resin-based material, i.e. with no rubber component, to completely rubber-based material, i.e. with no resin binder. Then the influence of rubber component on the mechanical, physical, frictional, wear and fade characteristics was explored. The COF of rubber-based materials became bigger compared to resin-based materials at higher sliding velocities. The wear resistance of resin-based materials was higher than that of rubber-based composites. This behavior was attributed to coverage of friction surface with strongly adhered multilayer secondary plateaus which plays the protective role to the underlying surface.
S.G. Amaren et al. [4] investigated the effect of periwinkle shell particle size on the wear behavior of asbestos free brake pad. The asbestos free brake pad was produced by varying the periwinkle shell particles was from +125 to+710 um with phenolic resin as the binder. The wear test was performed using pin on disk machine by varying the sliding speed, applied load, temperatures and periwinkle shell particle size.
K.W. Liew et al. [5] studied the tribological properties difference of potentially new designed non-commercial brake pad materials with and without asbestos under various speed and nominal contact pressure. The two fabricated non-commercial asbestos brake pad (ABP) and non-asbestos brake pad (NABP) materials were tested and compared with a selected commercial brake pad (CMBP) material using a pin-on-disc tribotest rig under dry contact condition. Results showed that friction coefficients for all materials were insensitive to increasing speed and pressure.
U.D. Idris et al. [6] has produced new brake pad using banana peels. The use of asbestos fiber is being avoided due to its carcinogenic nature that might cause health risks. A new brake pad was produced using banana peels waste to replaced asbestos and Phenolic resin (phenol formaldehyde), as a binder was investigated. The resin was varying from 5 to 30 wt% with interval of 5 wt%. Morphology, physical, mechanical and wear properties of the brake pad were studied. The results shown that compressive strength, hardness and specific gravity of the produced samples were seen to be increasing with increased in wt% resin addition, while the oil soak, water soak, wear rate and percentage charred decreased as wt% resin increased. The samples, containing 25 wt% in uncarbonized banana peels (BUNCp) and 30 wt% carbonized (BCp) gave the better properties in all. The result of this research indicates that banana peels particles can be effectively used as a replacement for asbestos in brake pad manufacture.
T. Singh et al. [7] brake pad hybrid phenolic composites based on lapinus–aramid fibre combination are designed, fabricated and characterized for various physical, chemical, mechanical, thermo-mechanical and tribo-performance. The physical properties such as water absorption, compressibility, void and ash contents increased with increase in lapinus fibre, whereas mechanical (such as hardness, impact energy, tensile and flexural strengths) and thermo-mechanical (loss-tangent, storage and loss modulus) properties increase with increased in aramid fibre. The assessment of braking performance is done using a standard test protocol conforming to ECE R-90 regulation on the Krauss friction testing machine. Comprehensively, it was found that incorporation of higher metallic-silicate lapinus fibre in formulation relative to aramid enhanced the overall frictional response.
V. Matejka et al. [8] studied the effect of silicon carbide (SiC) on friction–wear properties of semi-metallic friction composites (FC). Semi-metallic FC with increasing content of silicon carbide (SiC: 0, 3.4, 5.6, 9 and 14.6 vol.%) were prepared and slide against cast iron disc and their friction and wear properties were evaluated. The friction coefficient was observed to increase with SiC content, nonetheless the highest content (14.6 vol.% of SiC) did not significantly increase its value. The friction

coefficient of the composite SiC-3.4 (the lowest SiC content) was found to be the most stable. The volume wear rate (*V*) of tested friction composites slightly increases with SiC content and temperature.

R. Ertan et al. [9] investigated a brake lining composition was experimentally to investigate the effects of the manufacturing parameters on the tribological properties and to obtain optimal manufacturing parameters for improved tribological behaviour. The friction tests were performed using a Chase-type frictiontester to find the relationship between the manufacturing parameters and tribological properties, such as the wear resistance and friction stability, depending on the test temperature and the number of braking. The density and roughness were also analyzed in relation to the manufacturing parameters. The results showed that manufacturing parameters can substantially improve the tribological behaviour and manufacturing cost of brake lining as long as optimum values are chosen. It was found that as the molding pressure or heat treatment temperature increases, the density increases. As the molding time increased, the tribological characteristics improved remarkably. Also as the molding pressure increased, the average COF of the brake lining increased, given constant heat treatment parameters, molding temperature and time.

Z. Stadler et al. [10] studied the friction and wear of sintered metallic brake linings on a C/C-SiC composite brake disc. The friction and wear properties of sintered metallic (MMC) brake linings, which appear to combine well with a C/C-SiC brake disc. The friction characteristics were examined with a dynamometer on two different commercial motorcycle brake systems, differing in terms of the brake caliper and the dimensions of the disc. The influence of the components, such as graphite, and the abrasives in the metallic matrix on the formation of the friction layer was investigated using a scanning electron microscope (SEM) equipped with energy-dispersive X-ray spectroscopy (EDX). The friction layer formed on the pads sliding surface by oxidation wear, which consisted mostly of iron and copper oxides, was confirmed. The friction properties of the sintered metallic brake pads were determined and related to the composition and structure of the brake lining.

3.CONCLUSION

The materials used for the manufacturing of brake pad should be eco-friendly like the organic materials. Composite materials are now used widely due to its mechanical and physical properties. For superior brake friction properties such as a constant coefficient of friction under various operating conditions, resistance to heat, low wear rate, etc. composite materials should be preferred. Also the carcinogenic nature of asbestos materials makes selection of composite materials an automatic choice.

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