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ENHANCEMENT IN COMPOSITE MATERIAL USED FOR AUTOMOTIVE BRAKE LINER

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Abstract - As per regulation of Public Safety Standards of the Republic of India Transport Engineering regarding automotive vehicle brake lining material Part I and part II Specification and material and their range is made available under IS 2772 to the public under the provisions of the Bureau of Indian Standards Act of 1986 and the Right to Information Act of 2005. In order to promote public education and public safety, a better-informed citizenry, the rule of law. In this work rang and material for development of brake liner composition has been taken as per IS code 2472 applicable on automotive brake liner. Present paper investigate that the selection of brake friction materials is based on as per regulation of Public Safety Standards of the Republic of India code IS 2472.

Keywords- Filler, Wear, coefficient of friction, Abrasive, Binder, Lubricants, Reinforcement.

I. INTRODUCTION

Performance of a brake system in the automotive vehicle is predominantly determined by the wear and friction behavior of a friction material, friction and wear phenomena take place between frictional material and a gray iron disk (or drum)., The friction liner material, in particular, is considered as an important part for the performance of a vehicle, and is often responsible for various brake-induced problems such as low wear, fade phenomena, low coefficient of friction. This is true because the modification of brake performance by changing the friction material and its composition is relatively easier for the vehicle manufacturer rather than altering other specifications of brake systems. As a result the brake liner industry has seen the birth of different brake pads and shoes in the past decade each with their own unique composition yet performing the very same task and claiming to be better than others. Present paper investigate that the selection of brake friction materials is based more on tradition and experimental trial and error rather than fundamental understanding.

The brake linings generally consist of different material embedded in polymeric matrix along with several other ingredients. The use of traditional asbestos fiber and others material is being avoided due to its carcinogenic nature.

A new friction material (lining) and brake pad for heavy vehicle, such as, trucks and bus has been developed. Physical properties of this new material along with wear properties have been determined and reported in this paper. The brake is an important safety device vehicle. Various types of brake materials are used in different vehicle. The manufacturing cost involved in the component development using aluminum matrix composites is high. In automotive industries brake pads/liners are made from friction material. Friction materials have evolved from simple formulations containing fifteen ingredients to complex composites with as many as fifteen components. Several formulations have been developed for higher performing products. Several samples having asbestos-free compositions were prepared and their physical and wear properties were evaluated. Apart from these properties sliding wear and abrasive wear properties were evaluated and studied.

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International Research Journal of Engineering & Applied Sciences, IRJEAS
www.irjeas.org, ISSN(O): 2322-0821, Volume 9 Issue 3, Jul 2021-Sep 2021, Page 05-09

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II. OBJECTIVE

The objective of Presented work is to investigate that the selection of brake friction materials is based on as per regulation of Public Safety Standards of the Republic of India code IS 2472.

III. MATERIALS AND METHODS

The primary Function Friction Liner is to rub against the drums of the trucks and gradually reduce its speed [4-7]. During manufacturing process and rubbing process some particle and gases come out and they are harmful for environment as well as human health [8-11].

Traditionally the number of ingredient for friction brake liner are more than hundreds [6-8] but as per IS 2472 code suggest fifteen material in this group of fifteen material include abrasive, binder, fillers, lubricants, reinforcement fibers as per IS code these group of material are ecofriendly then other traditional material[3].

In this work a composite material will be developed using ingredients suggested in IS 2742. As per IS 2742 material and their limit has been prescribed in manual of IS 2472 for brake liner [2]. So in this work a composite material will be developed using ingredients and their limit suggested in IS 2742.

As per IS 2472 following ingredient has been recommended. This material has been recommended in Indian standard for brake liner due to their less effect on environment.

In this work three samples has been made lower range sample L medium rang sample M and high range sample H. the composition of these specimen is given below.

Sr. No	**Variable Factor**	**Function**	**Lower limit**	**Upper limit**
1	Lapinus RB 250	Fibers	5	10
2	Indian Rockwool	fiber	5	10
3	Ceramic Fiber	fiber	4	5
4	Steel Wool	fiber	3	5
5	Vermiculate	fiber	2.5	4
6	Calcimined Alumina	abrasive	5	8
7	Coarse Silica	abrasive	4	2
8	St Phenolic Resin	binder	10	25
9	Friction Dust	abrasive	5	7
10	Mica Flakes	abrasive	4	5
11	Barites	fillers	15	20
12	Synthetic Graphite	lubricants	6	9
13	Zinc Oxide	fillers	4	5
14	Black Iron Oxide	abrasive	4	5
15	Glass Fiber 3mm	Fibers	6	9

Table 3.1 - Ingredient as per IS code 2472.

IV. MANUFACTURING OF SAMPLE

This essentially contains fifteen materials given in table binder, reinforcement fibers, friction modifier, fillers, and few more chemical additives to achieve the desired properties of composite [12-16]. Above fifteen additives were dry mixed in a mixer and then transferred to a mold kept in a hot platen press at 140°C at 1000 kgf /cm^2 pressure for 10 min. After removal from hot press, the material was cured at 120°C in an oven for 24h. Test pieces were cut to determine various properties as described (17-19).

In this work three samples L, M, and H have been manufactured with above mentioned process. The composition has been taken as per mentioned in table 4.1 for three samples L, M, and H.

Sample H COMPOSITION	**Sample M COMPOSITION**	**Sample L COMPOSITION**	**COMPOSITION**
5	6	10	Lapinus R B 250
5	6	10	Indian Rockwool
4	3	5	Ceramic Fiber
3	3	5	Steel Wool
2	2.5	4	Vermiculate
6	8	5	Calcimined Alumina
1	2	4	Coarse Silica
25	10	10	St. Phenolic Resin
5	7	5	Friction Dust
4	5	4	Mica Flakes
18	18	18	Barites
8	9	6	Synthetic Graphite
5	5	4	Zinc Oxide

International Research Journal of Engineering & Applied Sciences, IRJEAS
www.irjeas.org, ISSN(O): 2322-0821, Volume 9 Issue 3, Jul 2021-Sep 2021, Page 05-09

7	9	6	Black Iron Oxide
2	2.5	2.5	Glass Fiber 3mm
100	100	100	TOTAL

Table 4.1 – Composition of samples L,M & H.

V. TESTING OF BRAKE PAD SAMPLE

In the present work studies have been carried out to assess the Friction and Wear behavior of developed composite material used for brake liner of truck under controlled laboratory condition. A comprehensive picture of wear under different working conditions has been presented by conducting laboratory tests in pure dry sliding mode using a pin-on-disc machine

Coefficient of friction and wear resistance, calculated. The Sliding wear measurements were taken on the all three samples on a pin-on- disc machine model SI-412 C Ducom (India). abrasive wear test were carried out using a Suga abrasion tester (Japan) model NUS-1 at different loads, such as, 90N, 100N, 110 N. Scanning electron microscope (SEM) studies of worn surfaces of the samples were carried out using JSM-5600 JEOL (Japan) model, after gold polishing on samples.\

VI. RESULTS AND DISCUSSION

The developed composition is complex as fifteen ingredients are used in formulation of frictional material. Three different composite samples with varying quantity of fifteen ingredients were manufactured to observe their tribological effect. Composition sample L contain maximum fiber and abrasive and binder were taken in lesser quantity. While, in composition sample M fibers quantity were reduced and abrasive quantity were increased. Whereas in composition H the quantity of binder has been increased while fibers and abrasive quantity reduced.

Figures 6.1 to 6.3 show the variation in abrasive wear rate with sliding distance at different applied load for three different compositions of materials L, M and H, respectively. These figures indicate that sample H has lowest wear rate.

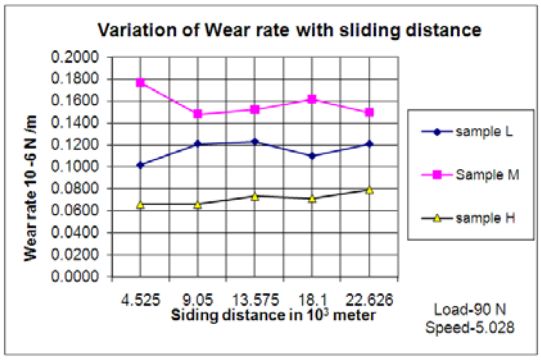

Figure 6.1 - Graph between wear rate and sliding distance of sample L

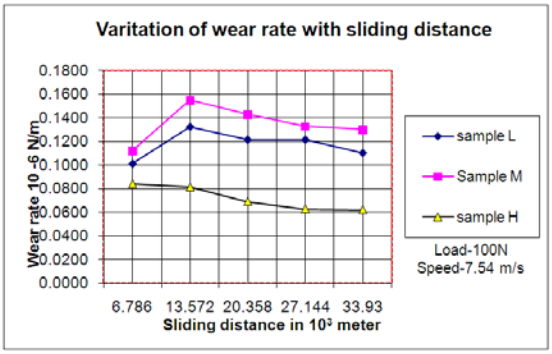

Figure 6.2 Graph between wear rate and sliding distance of sample

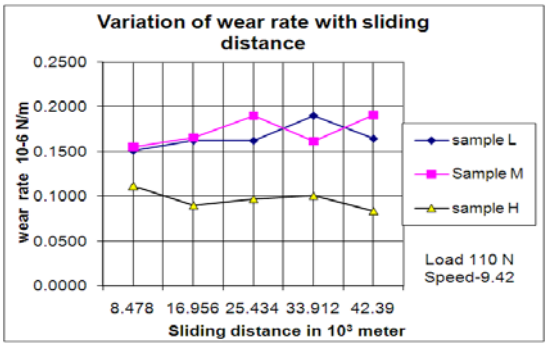

Figure 6.3 Graph between wear rate and sliding distance

Above three figures show the effect of sliding distance on abrasive wear volume of these developed brake pad samples at 90 N applied load. Wear losses in these samples are different. Sample H is more wear resistant as compared to sample M and sample L. This difference is due to the change in composition of three friction materials. The fiber content is higher in sample L as compared to sample M in which abrasive quantity is high. On increasing matrix the, wear resistance increases. This improvement is attributed to higher volume fraction of structural indignity of matrix material.

International Research Journal of Engineering & Applied Sciences, IRJEAS
www.irjeas.org, ISSN(O): 2322-0821, Volume 9 Issue 3, Jul 2021-Sep 2021, Page 05-09

Analysis of coefficient of friction

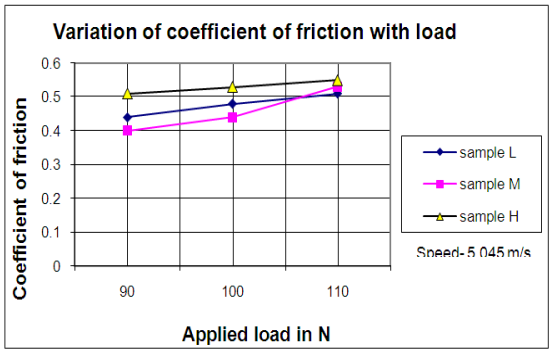

Figure 6.4 Graph between coefficient of friction and sliding distance

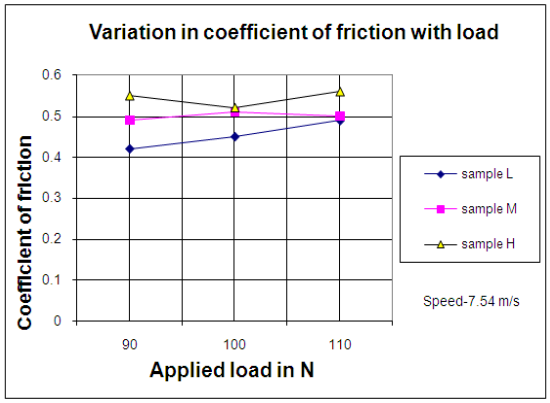

Figure 6.5 Graph between coefficient of friction and sliding distance

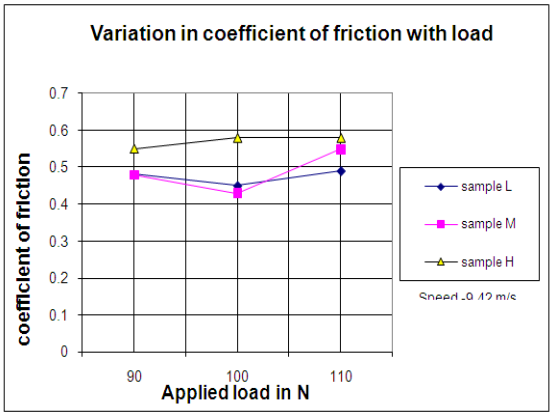

Figure 6.6 Graph between coefficient of friction and sliding distance

On the basis of plotted graph for COF (6.3 -6.6) this is concluded that, the study of friction coefficient suggest that the frictional properties of sample H is having highest coefficient of friction with minimum variation. The coefficient of friction is always above to 0.5 which is desirable properties for brake liner material.

VII. CONCLUSION

This research work has developed a composite material with minimum wear rate and maximum coefficient of friction as compared with that of similar materials available for the same application. A reduction in wear and increase in coefficient of friction shall yield an increased life of brake liner together with good frictional resistance. On considering the properties of the sample H, it has low wear rate and high coefficient of friction hence this is concluded that

1. Sample H friction composition can be developed by replacing traditional composition with this suitable formulation.
2. Wear decreases with the decrease in ratio of fibers and Abrasive in the Abrasive formulation.
3. This Sample H friction lining material can be used for brake as well as other friction lining applications

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