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Performance Analysis Of Non Asbestos Disc Brake Pad

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Abstract: *Brake is Important device of the vehicle used to stop vehicle with proper control of driver it stops the vehicle by converting kinetic energy in to mechanical energy, the stopping of vehicle is done because of frictional and rubbing action between the Disc and Disc Brake Pad (in case of Drum Brake it is between Drum and Brake liner) so it's important to produce a Proper Disc Brake pad material which produce Which produce proper rubbing action.*

INTRODUCTION:

In old days Asbestos materials are used because of its different characteristics like thermal stability up to 500^0c and them it produces silicates, its ability to regenerate frictional surfaces, it wear well, and its reasonable market cost but research shows that asbestos material damages the lungs,R respiratory system, Kidney failure, and causes cancers so Environmental Protection Agency Ban on Asbestos Material so it is necessary to replace The Asbestos material which gives similar effect of asbestos and which is Eco friendly to check performance analysis different test like Hardness test, Fade and Recovery , Wear ,Specific Gravity, and more test are conducted

this paper focus on Composition to replace Asbestos disc brake pad and to analyze performance by analyzing the most effective test i.e. Fade test (Prolong application of brake during maximum temperature within very less time)where maximum failure of brake occur on Friction testing machine and Actual Field Trial Testing.

Composition of Brake Pad: there are more than 2000 material available to use with different composition but the light commercial vehicle generally uses 10 to 12 material with different percentage to manufacture disc brake pad as per the knowledge of literature survey and company Expert and different testing, A non-asbestos brake material are mainly contents 1. Fibre Rainforcement.2. Resin Binders 3. Friction modifiers 4. Fillers & Abrasive, Detailed explain below.

1.Fibre Reinforcement: The purpose of this is to provide heat resistance and stable coefficient of friction Kevlar, Ceramic fibre, Basalt, Cellulose, glass fibre, polyester are some material which are used, these are used generally up to 50%.

2.Resin binders: these are used to bind all the material in to solid form these are generally used up to 30%.

3.Friction Modifiers: It basically used to adjust friction level, minimize the noise level and to reduce wear. Are used generally up to 20%.

4. Fillers and Abrasive: It is used for giving constant hardness, Wear and to control Dust to avoid air pollution.

The most important parameter is selection of parentage of weight and element in the formulation may alternate the physical, chemical and mechanical properties of the brake pad material developed.

Following are the formulation used in disc brake pad the and them the test are conducted as per The SAE J661 and IS standard to analyze whether they are able to replace the Asbestos material.

The composition of Two Samples:

Table 1: Material composition showing the constituents and their respective percentage by weight.

Sr.No	Material	% by Weight
1	Ceramic Fibre	9
2	Steel Wool	30
3	Alunimun Oxide	8
4	Calcium Carbonite	6
5	Resin PR 201	10
6	Friction Dust	4
7	Lapnius RB 250	6

8	Natural Barytes	15
9	Syn.Graphite	8
10	Copper Powder	4

Table 2 : Composition of materials with their corresponding percentage by weight.

Sr.No	Material	% by Weight
1	Ceramic Fibre	7
2	Steel Wool	24
3	Alunimun Oxide	5
4	Kevlar	8
5	Resin	9
6	Friction Dust	5
7	Anitmony Trioxide	4
8	Natural Barytes	15
9	Lapnius RB 250	6
9	Syn.Graphite	8
10	Copper Powder	5
11	Whiting powder	5

The testing of these sample as per the SAE J661 Standard and IS 2742(Part-2):1999
Principal of Link Chase Machine: the test carried out on the link chase is as per the SAE J661 one inch by one-inch sample is mounted on the link chase holder which is hydraulically operated and slot is provided to hold the sample after that the drum on which is sample is rubbing is rotated with the help of motor after the desired speed (or in case of fade desired temperature) is achieved as per test schedule the brake is applied and the μis measured.

Table 3: Specifications of the machine with parameters, units, operating range, and remarks.

Sr.No.	Parameters	Unit	Min	Max	Remark
1	Drum Speed	Rpm	0	1200	
2	Test Load (Load Cell)	N	0	2000	
3	Drum Temperature	Degree C	0	750	Controlled with J661 requirement
4	Drum Inner Dia	MM	277	289	

Machine Important parameters

1measuring drum speed.
2load cell to give frictional force
2 drum temperature.
3 heater used for heating the drum.
4 heating rate
5 blowers for cooling the drum
6 measuring frictional force (1.3 kg max).
Accuracy of measurement

1. Temperature ± 2% full scale accuracy
2. Friction force ± 2% full scale accuracy
3. Drum speed ± 2% full scale accuracy

Drum heating
Speed – 411 rpm
Cool 149 to 93 °c with cooling air and then cool to 82°c with cooling air off
82 to 221°c ±14 °c in 10 minutes
Drum cooling
345 to 93 °c ±14°c in 10 minutes

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Fade Test:

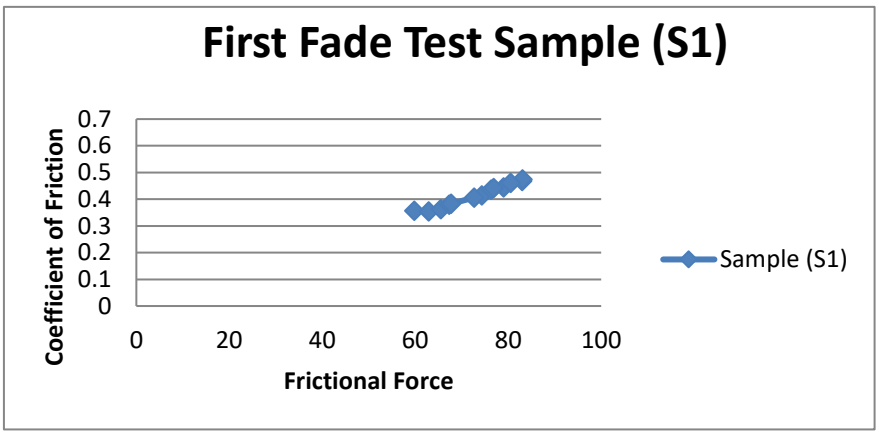
First Fade Test for Sample (S1)

In this test as per SAE procedure In fade-I test done at the constant speed of 411rpm and load at 540N Where frictional force was recorded continuously at nearly 40^0C intervals while drum temperature rise to 550^0C.

Table 4: Results of the first fade test showing frictional force, coefficient of friction (μ), and corresponding machine drum temperature.

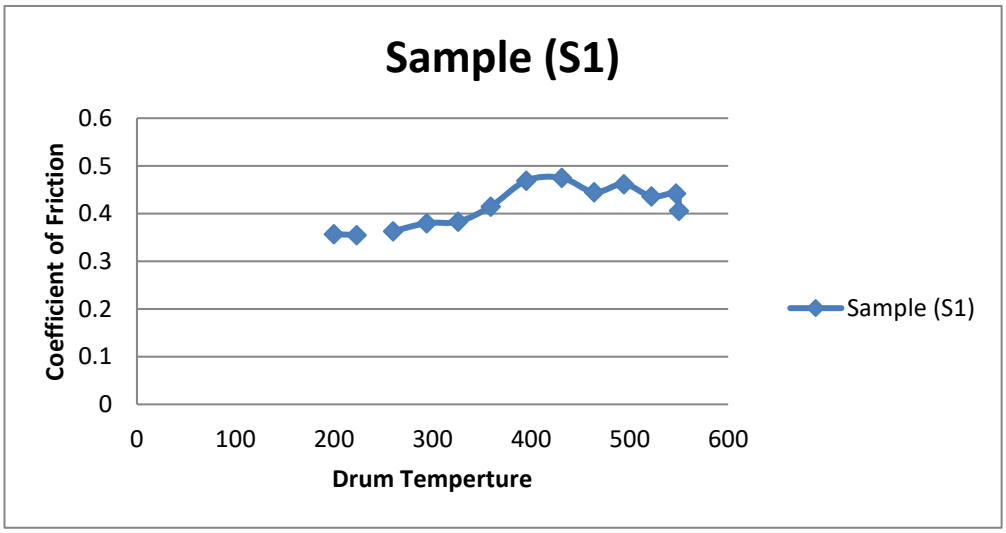
Frictional Force	μ	Machine Drum Temperature(Degree F)
59.8	0.357	200
62.9	0.355	223
65.5	0.363	260
67.3	0.380	294
67.7	0.383	326
74.3	0.415	359
83.0	0.469	395
83.1	0.475	431
79.0	0.445	464
80.5	0.462	494
76.3	0.436	522
76.9	0.442	547
72.7	0.406	550

Results and Discussion: The Graph between Coefficient of Friction and Frictional Force is Plotted to analyze the effect of Frictional force on
μ It shows as the frictional force increases the
μ Increases the maximum frictional force is 83.1 and minimum 59.8 and The maximum coefficient of Friction is 0.475 and Minimum 0.355 The Standard Deviation of coefficient of friction is 0.0419 and coefficient of variation 10% it shows the very Stable coefficient of friction during the Fade Test.



Graph 1: Coefficient of Friction Vs Frictional Force

The Graph between Coefficient of Friction and Drum Temperature for fir st fade test is Plotted to analyze the effect of Drum temperature on Coefficient of Friction Initially the as the drum temperature increases the coefficient of friction increases but when it achieves 400^{0}c it will start decreases and stable at nearly 0.380 The Standard Deviation of coefficient of friction is 0.0419 and coefficient of variation 10% it shows the very Stable coefficient of friction during the Fade Test .



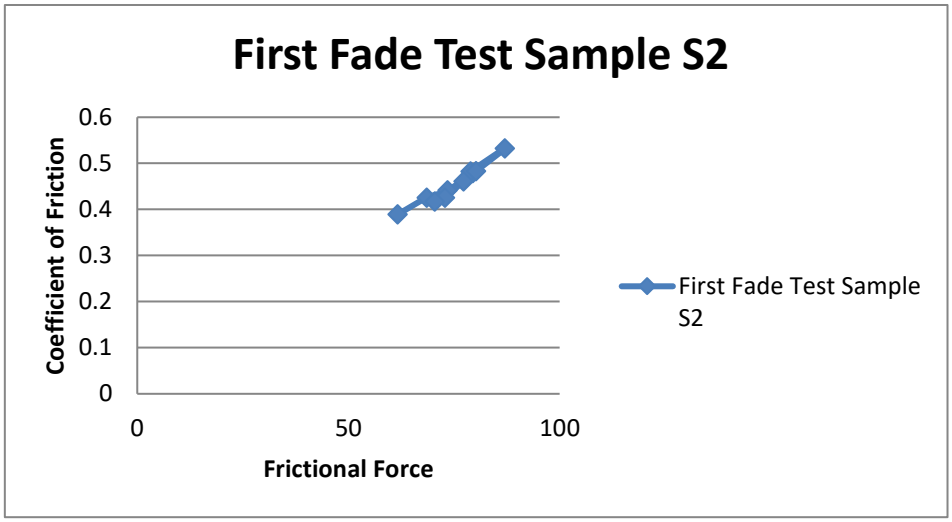
Graph 2: Coefficient of Friction Vs Drum Temperature

First Fade Test for Sample (S2)

In this test as per SAE procedure In fade-I test done at the constant speed of 411rpm and load at 540N Where frictional force was recorded continuously at nearly 40^{0}C intervals while drum temperature rise to 550^{0}C.

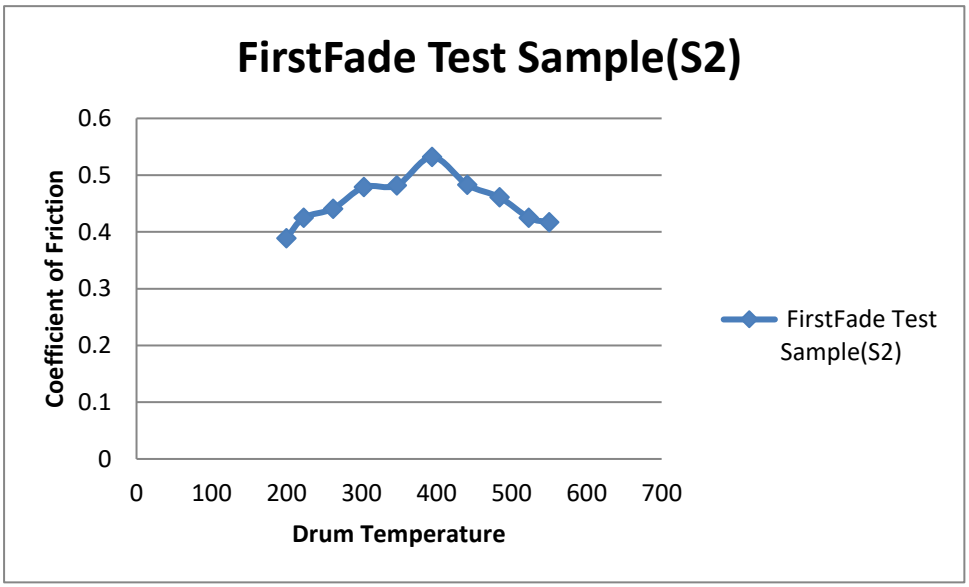
Table 5: Variation of frictional force and coefficient of friction of brake material with machine drum temperature.

Frictional Force	Coefficient Of Friction of Brake Material	Machine Drum Temperature(Degree F)
61.6	0.389	200
68.5	0.425	223
73.4	0.441	262
79.4	0.479	303
78.9	0.482	347
87	0.532	394
80.2	0.483	441
77.2	0.461	484
72.8	0.425	523



Graph 3: Coefficient of Friction Vs Frictional Force

Result And Discussion: The Graph between Coefficient of Friction and Frictional Force is Plotted to analyze the effect of Frictional force on Coefficient of Friction It shows as the frictional force increases the Coefficient of Friction Increases the maximum frictional force is 87 and minimum 61 and The maximum coefficient of Friction is 0.532 and Minimum 0.389 The Standard Deviation of coefficient of friction is 0.0389and coefficient of variation 8.77% it shows the very Stable coefficient of friction during the Fade Test.



Graph 4: Coefficient of Friction Vs Drum Temperature

The Graph between Coefficient of Friction and Drum Temperature for fir st fade test is Plotted to analyze the effect of Drum temperature on Coefficient of Friction Initially the as the drum temperature increases the coefficient of friction increases them when it achieves 400^0c it will start decreases and stable at nearly 0.40 389 The Standard Deviation of coefficient of friction is 0.0389and coefficient of variation 8.77% it shows the very Stable coefficient of friction during the Fade Test.

5 Second Fade Test for Sample (S1)

In this test as per SAE procedure In fade-I test done at the constant speed of 411rpm and load at 540N Where frictional force was recorded continuously at nearly 40^0C intervals while drum temperature rise to 650^0C

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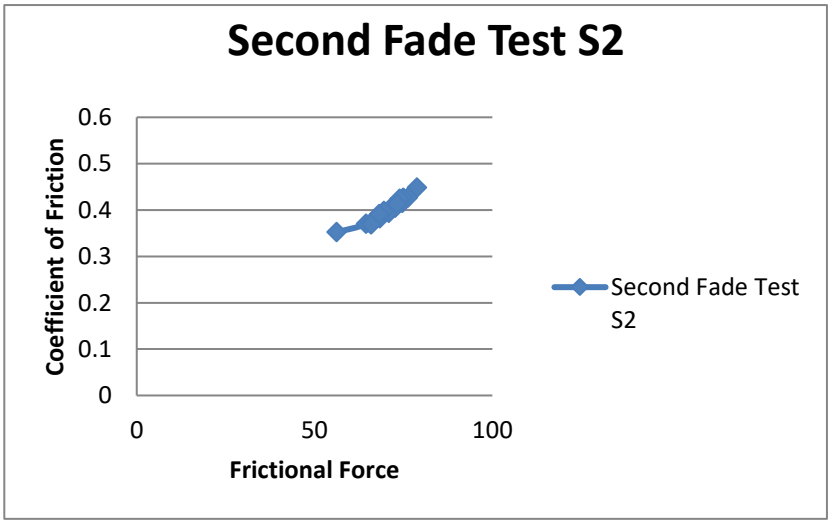
Table 6: Variation of frictional force and coefficient of friction of brake material with machine drum temperature.

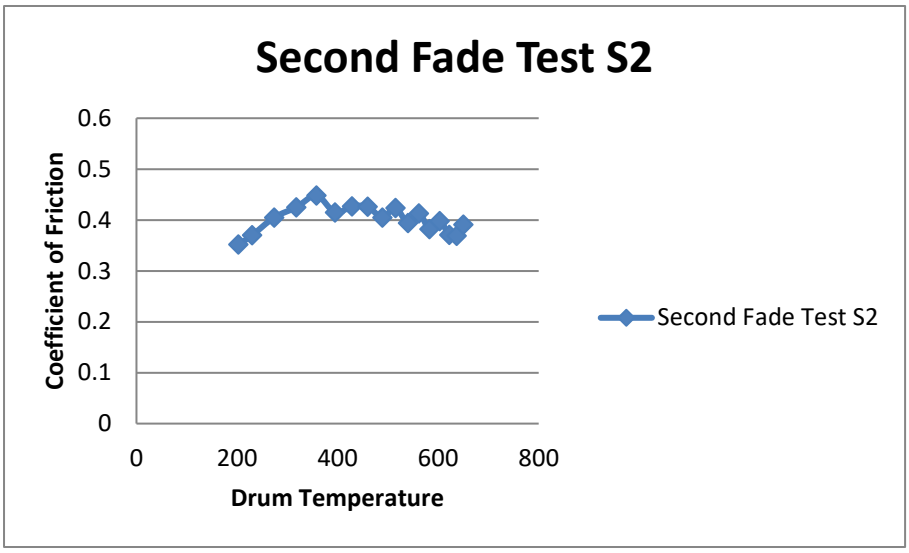
Frictional Force	Coefficient Of Friction of Brake Material	Machine Drum Temperature(Degree F)
56.2	0.352	203
64.5	0.370	230
71.5	0.405	274
75.1	0.425	318
78.8	0.448	358
74.6	0.415	395
76.3	0.427	429
74.9	0.426	460
72.7	0.405	489
73.9	0.424	515
70.9	0.394	540
73.2	0.413	562
68.3	0.382	583
69..5	0.398	603
65.6	0.371	622
65.9	0.369	637
68.2	0.391	650

RESULT AND DISCUSSION: The Graph between Coefficient of Friction and Frictional Force is Plotted to analyze the effect of Frictional force on Coefficient of Friction It shows as the frictional force increases the Coefficient of Friction Increases the maximum frictional force is 78.8 and minimum 56.2 and The maximum coefficient of Friction is 0.448 and Minimum 0.352 The Standard Deviation of coefficient of friction is 0.02520and coefficient of variation 6.48% it shows the very Stable coefficient of friction during the Fade Test.



Graph 5: Coefficient of Friction Vs Frictional Force

The Graph between Coefficient of Friction and Drum Temperature for Second fade test is Plotted to analyze the effect of Drum temperature on Coefficient of Friction Initially the as the drum temperature increases the coefficient of friction increases them when it achieves 400^0c it will start decreases and stable at nearly 0.370 . The Standard Deviation of coefficient of friction is 0.02520and coefficient of variation 6.48% it shows the very Stable coefficient of friction during the Fade Test.



Graph 6: Coefficient of Friction Vs Drum Temperature

Conclusion: Both these sample Are able to replace the Asbestos Material as they perform better than Asbestos up to 600^0 F Temperatures (i.e. up to 350^0

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