Scientific Journal of Impact Factor (SJIF): 4.72
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 12, December -2017

A REVIEW ON WEAR ANALYSIS OF BRAKE PAD MATERIAL

Mr.V. S. Chavan[1], Prof. S. D. Kachave[2], Prof. H. P. Deshmukh[3]

[1]*Student, Department of Mechanical Engineering,*
SSVPs B. S. Deore College of Engineering, Dhule, MS India 424001

[2]*Asso Professor, Department of Mechanical Engineering,*
SSVPs B. S. Deore College of Engineering, Dhule, MS India 424001

[3]*Asstt Professor, Department of Mechanical Engineering,*
SSVPs B. S. Deore College of Engineering, Dhule, MS India 424001

Abstract: -*Braking system is the very important part of automobiles. Brake pad is made up of composite materials, different types of materials are available for brake pads. Brake pad material is made up of different compositions. In order to study the performance of brake pads it is necessary to study its two properties viz.Wear and Coefficient of Friction. These tribological properties are found by using Pin on Disc type friction and wear apparatus. After reviewing various papers it is found that wear rate of brake pad material depends on velocity of sliding, sliding distance and load acting on materials. Wear rate also varies according to elements present in materials. Different compositions of material for brake pad have different wear rate. To satisfy all the requirements of brake pad Materials Brake pad is made of complex compositions. It is also found that lot of study is done on brake pad material for two wheelers but comparatively less study is done on brake pad material for Light motor vehicle.*

Keywords: *Brake Pads, Wear Rate, Compositions, etc.complex compositions*

I. INTRODUCTION

A **brake** is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction.Most brakes commonly use frictionbetween two surfaces pressed together to convert thekinetic energy of the moving object into heat, though other methods of energy conversion may be employed. For example, regenerative brakingconverts much of the energy toelectrical energy, which may be stored for later use. Other methods convert kinetic energy into potential energy in such stored forms as pressurized air or pressurized oil. Eddy current brakesuse magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms, for example by transferring the energy to a rotating flywheel.

Brakepadmaterialshouldhave
1 HighCoefficientofFriction
2 GoodThermalConductivity
3 MinimumWearRate
4.Goodwearresistancewhen subjected toheavyloadsandhighspeeds.

Friction and wear

Whenever two contacting bodies slide, roll, or separate with respect to each other, a force referred to as friction is produced at their interface, which opposes their movement. This friction force is usually accompanied by wear, the removal of material from either or both of the contacting surfaces. Friction and wear, as two kinds of responses from one tribo-system, must be exactly related with each other in each state of contact in the system, although a comprehensive simple relationship should not be expected. Technical senses of past tribologists, on the other hand, have already introduced successful methods of controlling wear without asking details of wear mechanisms. They are soft or hard film coating, multi-phase alloying and composite structuring in addition to traditional method of lubrication

II. LITERATURE REVIEW

Harshal P. Deshmukh, Navneet K. Patil[1], had study and analysed the three different compostions of semi metallic brake pads for wear rate under dry friction condition. In this paper three compostions are selected and detailed compositions of all three materials are obtained by EDX on scanning electron microscopy machine, experiment is designed by taguchi array in Design Expert software and experiment is performed on Pin on Disc test rig. Parametric relation is developed in the form of equation for each material compositions. At the end all three materials are compared on the basis of wear rate and coefficient of friction.

A. N Tiwari [2], had reviewed and studied Composite materials for automotive brakes, this paper presents a brief review of the materials technology involved in automotive friction materials. The aspects of Friction & wear, Ingredients of friction materials (classification functions and description) Different types of friction composites (organics, semi-metallic. Ceramicenhanced. sintered and carbon fiber reinforced materials), and Drum or disc materials.An attempt has been made to simplify the complexities and to develop an understanding ofthe materials aspects of friction materials while emphasizing current trends.

M. Ramesh, T. Karthikeyan, R. Arun, C. Kumaari, P. Krishnakumar and M.Mohankumar,[3] had study effects of applied pressure on the wear behavior of brake lining slidingagainst ferrous and nonferrous disc, In this paper they developed an indigenous pin on discwear test setup to study the wear behavior of truck brake lining material sliding againstlow carbon steel and aluminium disc. They had investigated the wear performance of thebrake lining pin with a EN32 and the aluminium A356 disc. Wear tests were carried out atlow applied pressure (0.05 to 0.2MPa) and high applied pressure (0.2 to 0.8MPa).Under two different speeds 1.24 and 3.42m/s for a constant sliding distance of 1000m. The wear rateof the brake lining pin sliding against the aluminium disc decreased than steel disc at highapplied pressure and low speed. However, the wear rate of brake lining pin sliding againstthe steel disc decreased than aluminium alloy at low applied pressure and high speed. Forall the sliding distances the wear rate of brake lining increased. The paper also shows wornsurfaces of disc track and EDAX pattern confirmed the presence of the main elements in thebrake lining material.

Deepak Bagale , Sanjay Shekhawat , JitendraChaudhari, [4] had study and analysedWear of polytetrauoroethylene and its composites under dry conditions using design-expert,they studied, the effects of load, velocity of sliding and sliding distance on sliding frictionand sliding wear of polymer material made of polytetrauoroethylene (PTFE) and PTFEcomposites with filler materials such as 40% bronze and 40% carbon in this paper. Theexperimental work is performed on pin-on-disc apparatus and analyzed with the help ofDesign-Expert 7 software. The addition of bronze and carbon filler to the virgin PTFEdecreases wear rate significantly and there is marginal increase in coefficient of friction .Thehighest wear resistance was found for 40% carbon filled PTFE followed by 40% bronze filledPTFE and virgin PTFE.

Dr.AhmetAkkus, MukadderYegin, [5] has studied Research on Wear Rate and MechanicalProperties of Brake Sabots (Shoes) Used in Railway Rolling Stocks, In this work,wear resistances, wear rates, friction forces and coefficients of pig-iron, composite and sinteredsabots (brake shoes) used in self-propelled or pulled transportation equipment as wellas their hardness-density, fracturing energies and chemical compositions, have been studiedexperimentally, Wear increases with the increases in sliding time, exerted force and speed.It is observed that in pig-iron sabots, friction coefficient, initially tended to reduce as slidingspeed increases and inclined to increase after 400rpm is exceeded. In composite and sinteredsabot samples, as the speed (sliding speed) increases, friction coefficient decreases. Average coefficients of friction for pig-iron is 0.44, sintered is 0.37 and composite sabots is 0.25. thisstudy shows that pig-iron sabot wears faster compared to composite and sintered sabot. Thepig -iron sabot of lifetime is 3 times shorter than that of composite sabot and 6 times shorterthan that of sintered sabot. Initial costs of sintered sabot are highest.

P.V. Gurunath, J. Bijwe, [6] has studied Friction and Wear for brake-pad materials basedon newly developed resin, they has developed a monomer in the laboratory and used as abinder for frictioncomposite. In this paper two types of non-asbestos organic (NAO) frictioncomposites with identical ingredients but differing only in the type of resin (10 wt%) weredeveloped and characterized for physical, thermal and mechanical properties. The brakepads were then tribo-evaluated for their fade and recovery performance as perECR 90 regulationon Krauss machine. It was observed that the composite with new resin (N) provedbetter than the composite with traditional phenolic (P).

Mohammad. Asif, [7] had done tribo-evaluation of Aluminium Based Metal Matrix CompositesUsed for Automobile Brake Pad applications, the study used Al- Based metal matrixcomposites for automobile brake pad applications are fabricated through 'Preform powderforging' technology. Dry sliding wear behavior of Al-MMC based brake pads against castiron disc is studied as per ECR R-90 regulation on Krauss machine tribo-tester. Study showsthat the Al- based brake pads possess lower wear rate, and shows same order of Coefficient offriction as in resin bonded brake pads, while the temperature rise is one third as comparedwith resin bonded brake pads. On the other hand the vibration and judder of Al basedbrake pads is slightly higher in comparison to resin based brake pad. The fracture surfaceof the brake pad is studied under SEM and it was found that the constituents are uniformlydistributed in friction layers as well as in backing plate.

G. Cueva , A. Sinatora , W.L. Guesser , A.P. Tschiptschin, [8] has studied Wear resistanceof cast irons used in brake disc rotors, They studied wear resistance of three different typesof gray cast iron namely gray iron grade 250, high-carbon gray iron and titanium alloyedgray iron, which are used in brake disc rotors, these three was studied and compared withthe results obtained with a compact graphite iron (CGI). The wear tests were carried out ina pin-on-disc wear-testing machine, the pin being manufactured from friction material usuallyused in light truck brake pads. The rotating discs (500 rpm) were subjected to cyclicalpressures of 0.7, 2 and 4MPa and forced cooled. The wear was measured by weighing discsand pads before and after the test. The operating temperatures and friction forces were alsomonitored during each test. The results showed that compact graphite iron reached highermaximum temperatures and friction forces as well as greater mass losses than the three grayirons at any pressure applied.

R.J. Talib, M.A.B. Azimah, J. Yuslina, S.M. Arif and K.Ramlan, [9] had done Analysison the hardness characteristics of semi-metallic friction materials, in this work, sevensamples of newly developed friction material formulations were subjected to Rockwell hardnesstests in accordance with Malaysia standard MS 474, Part 2. 2003. The samples weredeveloped through powder metallurgy technique consisting of the following processing stages;powder selection, weighing, compaction, post baking and finishing. The indention spots afterthe hardness tests were also observed using scanning electron microscope (SEM) and theelemental compositions on that area were analyzed using Energy Dispersive X-ray (EDX).Friction material is heterogeneous materials, the hardness the friction material depend onmany factors such as the type of ingredients and percentage used in the composition andthe dispersion of the ingredients in the composition. There is no simple correlation betweenhardness and swell and growth characteristics of friction materials. It depends on the manufacturingprocess as well as on how homogenous is the ingredient in formulation developed.
Microstructure of the friction material plays an important role in getting uniform hardnesseven though microstructure characteristic is not representing the bulk proprieties.

Sonam M. Gujrathi, Prof. L.S. Dhamande and Prof. P.M. Patare [10],Has done researchwork for developing a new material for industrial application. this literature is usedto refer the methodology of expermentation and analysis, they had done Wear Studies ofPolytetrauroethylene (PTFE) Composites using Taguchi Approach for conventional bearingapplication .In this study, the effects of varying load, sliding distance, sliding velocity and filler content in PTFE are experimentally evaluated. A comparison of analysis of threecomposites (PTFE, PTFE + 25% C and PTFE + 35% C) is done. A design of experimentis based on Taguchi technique. The results of experiments are shown in table which showsthat the wear is strongly influenced by the material composition and also by the selectedparameters for experimentation

III.METHODOLOGY

In order to find wear of material Pin on disc wear apparatus is used and experiment is designed using Taguchi array in Design Expert software

3.1 Pin on Disc Wear apparatus

This test method describes a laboratory procedure for determining the wear of materials during sliding using a pin-on-disk apparatus. Materials are tested in pairs under nominally non-abrasive conditions. The principal areas of experimental attention in using this type of apparatus to measure wear are described. The coefficient of friction may also be determined.
The pin specimen is pressed against the disk at aspecified load usually by means of an arm or lever and attached weights. Other loading methods have been used, such as,hydraulic or pneumatic.
Wear results are reported as volume loss in cubic Millimeters for the pin and the disk separately. When two Different materials are tested, it is recommended that each Material be tested in both the pin and disk positions.

3.2 Design Expert software

Design Expert is a software designed to help with the design and interpretation Of multi-factor experiments.The software offers a wide range of designs, including factorials, fractional factorials and Composite designs. It can handle both process variable such as rotor speed, and also Mixture variables
Design-Expert software offers an impressive array of design options and provides the flexibility to handle categorical factors and combine them With mixture and/or process variables. After building your design, generate a run sheet with your experiments laid out for you in randomized run order.

IV CONCLUSION

After reviewing various papers it is concludedthat:

1. In order to study the tribological properties of brake pads using Pin on Disc type friction and wear apparatus is most suitable.
2. Wear rate of brake pad material depends on velocity of sliding, sliding distance and load acting on materials.
3. Wear rate also varies according to elements present in materials i.e. wear rate of materials depends elements present in it.
4. Lot of study is done on brake pad material for two wheelers but comparatively less study is done on brake pad material for Light motor vehicles.

REFERENCES

[1] Harshal P Deshmukh, Navneet K Patil, "Experimentation and Analysis of Three Different Compositions of Semi-Metallic Brake Pads for Wear Rate under Dry Friction Condition", International Journal of Engineering Research & Technology (IJERT), Vol. 4 Issue 10, October- 2015.

[2] A. V. Purkar, Prof. Dr. E.R. Deore."Wear behavior of Aluminium Metal Matrix Composite with Silicon Carbide used for Brake Pads under Dry Friction Condition"International Advanced Research Journal in Science, Engineering and Technology, Vol. 3, Issue 6, June 2016

[3] Deepak Bagle, Sanjay Shekhawat, JitendraChaudhari,"Wear Analysis of Polytetrafluoroethylene and its Composites under Dry Conditions using Design-Expert", International Journal of Scientific

[4] A. N. Tiwari, R Ramakrishnan "Composite material for automotive brakes", Powder Metallurgy Processing for Automotive, Electrical Electronic and Engineering Industry, New age international (P) Ltd, ISBN81-224-2030-3, 2007, pp. 86-102.

[5] M. Ramesh, T. Karthikeyan, R. Arun, C. Kumaari, P. Krishnakumar and M. Mohankumar, "effects of applied pressure on the wear behavior of brake lining sliding against ferrous and nonferrous disc", International Journal of Advanced Mechanical Engineering, ISSN 2250-3234 Volume 4, Number 3 (2014), pp. 285-290.

[6] Ashish D. Dhangar, R. J. Jani, HirenBagada, "An Experimental Investigation of Effect of Process Parameters on Wear of Semi Metallic Automotive Disc Brake Friction material", International Journal For Scientific Research & Development, vol.2, 03, 2014.

[7] P.V. Gurunath, J. Bijwe, "Friction and wear studies on brake-pad materials", Wear 263 (2007) 1212–1219.

[8] Mohammad. Asif, "Tribo-evaluation of Aluminium Based Metal Matrix Composites Used for Automobile Brake Pad Applications based on newly developed resin", Plastic and Polymer Technology (PAPT) Volume 1 Issue 1, December 2012, pp.9-14.

[9] G. Cueva, A. Sinatora, W.L. Guesser, A.P. Tschiptschin, "Wear resistance of cast irons used in brake disc rotors", Wear 255 (2003), pp. 1256–1260.

[8] K.Deepika1, C.Bhaskar Reddy2, D.Ramana Reddy3, "Fabrication and Performance Evaluation of a Composite Material for Wear Resistance Application", (IJESIT) Volume 2, Issue 6, November 2013

[10] Pradnya Kosbe1, Chittaranjan More, "PERFORMANCE OF A NAO FRICTION MATERIAL FOR DISC BRAKE", National Journal on Advances in Building Sciences and Mechanics, Vol. 1, No.2, October 2010

[11] Pruthviraj R. D., "Wear characteristics of Chilled Zinc-Aluminium Alloy reinforced with Silicon Carbide Particulate composites", Vol. 1 (2) May (2011) Res.J.Chem.Sci.

[12] SS Rattan, "Theory of Machines", Copyright ©2005, 1993, by Tata McGraw-Hill Publishing Company Limited, Page 276-277, 300-304.

[13] Sarvendra Kumar Mehra, "A review of experimental study of brake pad material", International Journal of Emerging Trends in Engineering and Development Issue 3, Vol.6 (November 2013)

[14] Sridhar B S1, Raji George, "Synthesis of Silicon Carbide Based Composite Material for Industrial Applications", International Journal of Research in Advent Technology, Vol.2, No.9, September 2014 E-ISSN: 2321-9637

