A Review paper on Moulded and Woven non-asbestos Friction liners in Band Brake

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Abstract- *Band brakes find application in braking in various fields of application such a material lifting applications lifts, cranes and hoist. Material transport equipment like conveyors, parachutes, trolleys etc. Band brakes are common in these examples but with heavier loads the problem of band glazing is frequent. Glazing reduces the coefficient of friction between the brae drum and the liners leading to slip and thereby inaccurate positioning of the said load. Conventional liners are made as molded asbestos but with the present stringent environmental norms the asbestos liners are banned in operation hence there is need to develop high performance non-asbestos liners in molded condition. Woven brake linings are designed for all types of brakes and drum clutches in most critical applications. They feature high and stable friction coefficient and guarantee meeting the strictest safety requirements as their design assures resistance to rapid failures. Woven friction linings are difficult to mold and are used in lifting machine applications where high temperature and high pressure conditions are common*

Thus it is proposed to develop composite lining in band geometry in the molded form and woven form with FTL-097 as a base material and graphite insert material. It is expected that such linings are based on highly durable and heat resistance to temperature, featuring high friction coefficient of friction and high durability. Paper includes investigators work done on design and analysis on different parameters. This review can help analysts to choose right and optimum methods and to make decision on new methods of area of development.

Keywords- Brake Friction lining, Band Brake, Composite lining

I. INTRODUCTION

The band brake friction materials play an important role in braking system. They convert the kinetic energy of a moving machine to thermal energy by friction during braking process. The ideal band brake friction material should have constant coefficient of friction under various operating conditions such as applied loads, temperature, speeds, mode of braking and in dry or wet conditions so as to maintain the braking characteristics of a machine.

Besides, it should also possess various desirable properties such as resistance to heat, water and oil, has low wear rate and high thermal stability, exhibits low noise, and does not damage the brake lining and disc. However, it is practically impossible to have all these desired properties.

Therefore, some requirements have to be compromised in order to achieve some other requirements. Frictional material used in band brake pads is made up of four subcomponents which play different roles. These are; abrasives materials to modify friction, lubricants to stabilize developed friction, binders to hold different constituents together and prevent disintegration and fillers to improve manufacturability as well as lower the cost. Band brake lining pads and disc are required to maintain; a sufficiently high friction coefficient with the band brake lining, not decompose or break down at high temperatures and exhibit a stable and consistent friction coefficient. The friction and wear behavior of automotive brake linings is complex and depends on their composition, temperature, rubbing speed, pressure, and most importantly the surface characteristics of the counter face [2].

Reductions in stopping power that can occur after repeated or sustained application of the brakes is called as brake fade. An ideal brake lining is the one which provides uniform and stable friction under all the operating conditions without any fade [5]. The significance of friction material in material handling and earth moving machinery, commonly used friction material earlier contained asbestos as the base material mainly because of its property to resist deformation under action of heat generated due to friction. This review focuses on analysis of the brake friction lining material and other materials for band brake application.

II. OBJECTIVES OF RESEARCH

1. Determination of braking force required for braking at two operating load condition and selection of the braking system arrangement i.e. drum brake, external band brake caliper arrangement suitable for derived conditions.
2. Design Development & analysis of electro –mechanical solenoid mechanism with spring return for brake application

3. Design selection of solenoid suitable to generate the designed braking force
4. 3-D cad modeling using Unigraphics and analysis for strength of critical components of the band brake using ANSYS such as, input shaft , load drum load drum shaft ,brake liner in molded and woven form
5. Design & development of test-rig with band drum brake arrangement to test the developed composite brake liners
   a) 'Slip' determination for individual stages ie, two individual load conditions to derive the load positioning accuracy.
   b) Comparative study of theoretical braking force and brake energy consumption through experimental brake dynamometer testing thereby validation of experimental result to theoretical design.

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III. LITERATURE REVIEW

A. Bouchetara Mustafa, Belhocine Ali (2014)

Presented paper on thermo elastic Analysis of Disk Brakes rotor [5]. In this Paper the main purpose of this study is to analyze the thermo-mechanical behavior of the dry contact between the brake disk and pads during the braking phase. The simulation strategy is based on computer code ANSYS11. The modeling of transient temperature in the disk is actually used to identify the factor of geometric design of the disk to install the ventilation system in vehicles The thermal-structural analysis is then used with coupling to determine the deformation and the Von-Mises stress established in the disk, the contact pressure distribution in pads. The results are satisfactory when compared to those of the specialized literature.

B. Dr. S. B. Chikalthankar, Dr. V. M. Nandedkar (2013)

This paper presents on a Review & Literature of Frictional & Wear Characteristics of Non-Asbestos Brake Pad Using Link Chase Machine .The frictional and wear characteristics of non-asbestos brake pad were studied using link chase machine. The chase machine is used to perform the test as per SAE J661.The coefficient of friction and wear is an important performance measure in this process. Since long, researchers have explored a number of ways to improve and stable the coefficient of friction and wear rate which is similar to the asbestos material. A large range of different non-asbestos materials are studied by different researchers; all the research work in this area shares the same objectives of achieving the same performance from non-asbestos material as that of asbestos material. The paper reports research on relating to improve and stable the coefficient of friction and wear rate in the end of the paper scope for future research work has been outlined.[13]

C. K. Sowjanya & S. Suresh (2013)

Presented paper on Structural analysis of disk brake rotor .This paper Disc brake is usually made of Cast iron, so it is being selected for investigating the effect of strength variations on the predicted stress distributions. Aluminum Metal Matrix Composite materials are selected and analyzed. The domain is considered as axis-symmetric, inertia and body force effects are negligible during the analysis. The model of Disc brake is developed by using Solid modeling software Pro/E (Cero-Parametric 1.0).Further Static Analysis is done by using ANSYS Workbench. Thermal solution to the structural analysis and the maximum Von Misses stress was observed to be 50.334 M Pa for CI, 211.98 M Pa for AlMMC1, and 566.7 M Pa for AlMMC2, the Brake disc design is safe based on the Strength and Rigidity Criteria.

D. M.A. Maleque, A. Atiqah (2012)

Presented paper on new natural fiber reinforced aluminum composite for automotive brake pad. In this paper is to develop new natural fiber reinforced aluminum composite for automotive brake pad application. Four different laboratory formulations were prepared with varying coconut fiber contents from 0, 5, 10 and 15 volume fraction along with binder, friction modifiers, abrasive material and solid lubricant using powder metallurgy technique for the development of new natural fiber reinforced aluminum composites. The properties examined are density, porosity, microstructural analysis, hardness and mechanical properties using dens meter, SEM, hardness tester and universal testing machine. The better properties in terms of higher density, lower porosity and higher compressive strength were obtained from 5 and 10% coconut fiber composites. The microstructure reveals uniform distribution of resin and coconut fiber in the matrix. It can be concluded that 5 and 10% showed better physic-mechanical properties compared to other formulations. Hence, natural coconut fiber is a potential candidate fiber or filler material for the automotive brake pad material. [3]

E. A.M. Zaharudina, R.J. Talib (2012)

Presented paper on Taguchi method for optimizing the manufacturing parameters of friction materials [2]. This paper presents a Semi-metallic friction materials were produced by the powder metallurgy method. This study investigated the optimization of manufacturing parameters (molding pressure, molding temperature and molding time) for friction materials using the Taguchi Method. Physical

properties (hardness and specific gravity) and tribological properties (wear and fade) were selected as the quality target. It was determined that molding pressure has the strongest effect on physical and tribological properties. It was observed that friction materials with the optimal level of parameters proved to be the best performer in tribological characteristic.

F. Oder G. (2009)

Presented a paper on Thermal and stress analysis of brake discs in railway vehicles [7]. This paper present work on thermal and stress analysis of brake discs in railway vehicles. Performed analysis deals with two cases of braking; the first case considers braking to a standstill; the second case considers braking on a hill and maintaining a constant speed. In both cases the main boundary condition is the heat flux on the braking surfaces and the holding force of the brake calipers. In addition the centrifugal load is considered. Finite element method (FEM) approach is been used, 3D model has been modeled for analysis. Brake disc material is rounded graphite; two types of disc considered for studies one without wear and one with 7 mm wear on both sides. Maximum speed is 250 km/hr. and the ambient and initial disc and surrounding temperature is 50°C Temperatures and stress in discs under different loads is very high. Although they are fulfilling the buyer's requirements for safety, this investigation not considered shearing forces, residual stress and the cyclic loads during brake discs lifespan. The results need to be compared with experimental results.

G. Zaid (2009)

Presented a paper on an investigation of disc brake rotor by Finite element analysis [8]. In this paper, the author has conducted a study on ventilated disc brake rotor of normal passenger vehicle with full load of capacity. The study is more likely concern of heat and temperature distribution on disc brake rotor. In this study, finite element analysis approached has been conducted in order to identify the temperature distributions and behaviors of disc brake rotor in transient response. Modeling is done in CATIA & CAE has been used as finite elements software to perform the thermal analysis on transient response. Material used is Grey cast iron, with maximum permissible temperature 550 C. For load analysis 10 cycles of breaking and 10 cycles without breaking (idle) operation is considered total of 350 seconds. Result provided during 1st, 5th and during 10th cycle. Thus, this sure study provide better understanding on the thermal characteristic of disc brake rotor and assist the automotive industry in developing optimum and effective disc brake rotor. [15]

H. Ji-Hoon, Choi and Lee (2004)

Presented paper on Finite element analysis of transient thermo elastic behaviors in disk brakes.[6]. In this paper a transient analysis for thermo elastic contact problem of disk brakes with frictional heat generation is performed using the finite element method. To analyze the thermo elastic phenomenon occurring in disk brakes, the coupled heat conduction and elastic equations (Cylindrical coordinates) are solved with contact problem. Material used is carbon, carbon composite and wear is assumed negligible. The numerical simulation for the thermo elastic behavior of disk brake is obtained in the repeated brake condition. The computational results are presented for the distributions of pressure and temperature on each friction surface between the contacting bodies. It is observed that the orthotropic disc brakes can provide better brake performance than the isotropic one because of uniform and mild pressure distribution.

I. Masahiro Kubota (2000)

Presented paper on development of lightweight brake disc rotor. A design approach for achieving an optimum thermal, vibration and weight balance. This paper presents a parametric study that was conducted on the basis of an analysis of airflow through the ventilation holes as well as a thermal stress analysis and a vibration analysis during braking.[4] Based on the relationships obtained between rotor weight, shape and each performance requirement, a method is presented for designing a lightweight disc rotor. Computational fluid dynamics (CFD) analysis approach is used to visualize the actual process. Short and gourd shaped fins arrangement had been used and the results verified that anti-squeal performance was improved, and also a substantial weight reduction was achieved compared with the baseline rotor shape without causing cooling performance and heat resistance to deteriorate.

IV. PROPOSED WORK

Conventional liners are made as moulded asbestos but with the present stringent environmental norms the asbestos liners are banned in operation hence there is need to develop high performance non-asbestos liners in molded condition.

Woven brake linings are designed for all types of brakes and drum clutches in most critical applications. They feature high and stable friction coefficient and guarantee meeting the strictest safety requirements as their design assures resistance to rapid failures. Woven friction linings are difficult to mold and are used in lifting machine applications where high temperature and high pressure conditions are common

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V. CONCLUSION

This paper is review of various engineering aspects and parameters of the different composite brake lining materials incorporating their nature, behavior and properties. Hence in order to have an ideal brake lining material having constant coeffiecnt of friction at various operating loads, lower wear rate and heat resistant, different compositions and formulations can be done by changing the material type.

So for achieving more better results research work has to be carried out to develop a composite lining in band geometry in molded and woven form using FTL-097 as band material and using graphite as an insert.

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