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A Review Paper on Analysis of Moulded and Woven Non-Asbestos Friction Liners in Band Brake

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ABSTRACT

Band brakes find application in braking in various field of application such a material lifting applications lifts, cranes and hoist. Material transport equipment like conveyors, pschutes, 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 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 moulded condition. Thus it is proposed to develop composite lining in band geometry in the moulded form and woven form. Above liners are highly durable and heat resistance to temperature, high friction coefficient of friction ad high durability. The prime objective of project will be to investigate the performance of these band liners at various load and speed conditions and carry out the comparative analysis of the above said liners to determine the best suitable for given condition. The 3-d modelling friction and strength analysis of individual linings in plain an composite insert form for both materials will be done using ANSYS software. Developed linings in the moulded and woven form will be tested on band brake setup where in the individual lining in the mounted form will be tested to determine the power absorbed in friction , wear rate / 100 load cycles ,minimum braking distance / rotations.

Keywords: Band brake, Composite materials, Moulded form and woven form.

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, 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. In general, each formulation of friction material has its own unique frictional behaviours and wear-resistance characteristics. 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 behaviour 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. Temperature the organic compounds disintegrate, friction decreases, and wear rate increases exponentially.

LITERATURE REVIEW

1. K. Sowjanya & S. Suresh (2013), Presented paper on Structural analysis of disk brake rotor [1] In this paper Disc brake is usually made of Cast iron, so it is being selected for investigating the

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effect of strength variations on the predicted stress distributions. Aluminium 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 .

2. 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 (moulding pressure, moulding temperature and moulding 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 moulding 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.

3. M.A. Maleque, A. Atiqah (2012), Presented paper on New natural fibre reinforced aluminium composite for automotive brake pad [3]. In this paper is to develop new natural fibre reinforced aluminium composite for automotive brake pad application. Four different laboratory formulations were prepared with varying coconut fibre 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 fibre reinforced aluminium composites. The properties examined are density, porosity, microstructural analysis, hardness and mechanical properties using densometer, 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 fibre composites. The microstructure reveals uniform distribution of resin and coconut fibre in the matrix. It can be concluded that 5 and 10% showed better physico-mechanical properties compared to other formulations. Hence, natural coconut fibre is a potential candidate fibre or filler material for the automotive brake pad material.

4. Masahiro Kubota (2000), Presented paper on Development of lightweight brake disc rotor: A design approach for achieving an optimum thermal, vibration and weight balance [4]. 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. 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.

5. Bouchetara Mostefa, 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 behaviour 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.

6. Ji-Hoon, Choi and Lee (2004) presented a paper on Finite element analysis of transient thermo elastic behaviours 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 behaviour 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.

7. 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 callipers. In addition the centrifugal load is considered. Finite element method (FEM) approach is been used, 3D model has been modeled for analysis. Brake disc 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.

8. H. 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 behaviours of disc brake rotor in transient response. Modeling is done in CATIA & ABAQUS/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.

PROBLEM DEFINITION

Band brakes find application in braking in various fields of application such a material lifting devices like lifts, cranes and hoist & material transport equipment like conveyors, 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 brake drum and the liners leading to slip and thereby inaccurate positioning of the said load.

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 moulded condition. Though there are conventional composite liners are available but their performance is also not effective as they were lagging in coefficient of friction at various loads and speeds, hence the replacement is necessary over the period of time.

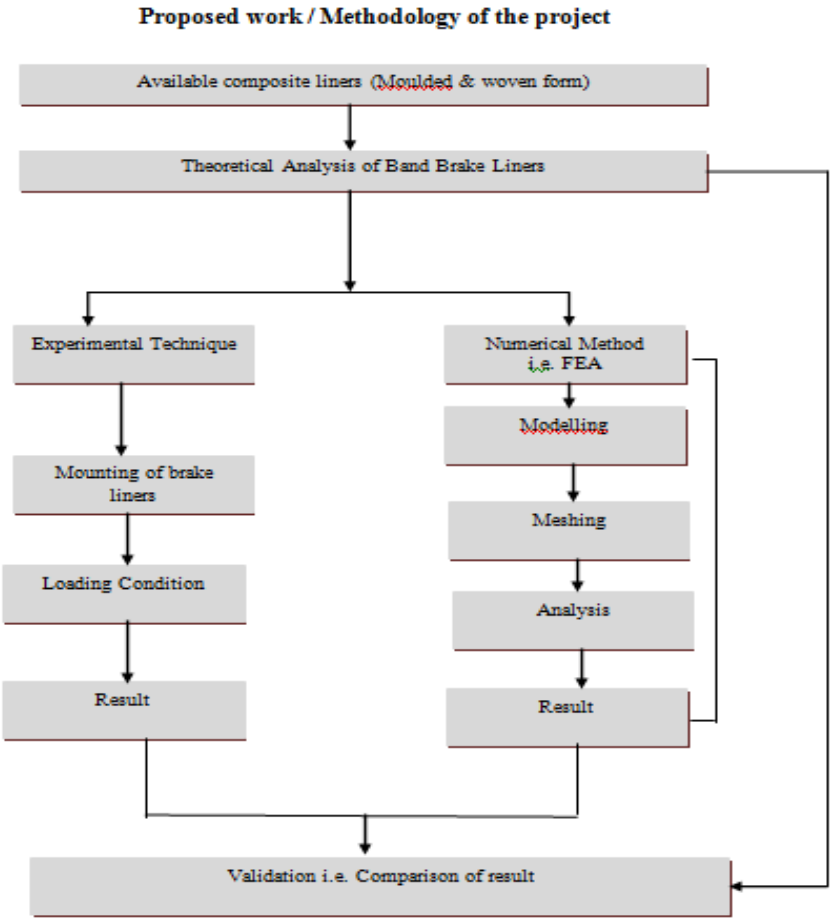
Thus there is a need to compare the available composite liners moulded and woven form so as to select the best liners for the various loads and speed condition. It is expected that such liners are based on highly durable and heat resistance to temperature, featuring high coefficient of friction.

OBJECTIVES

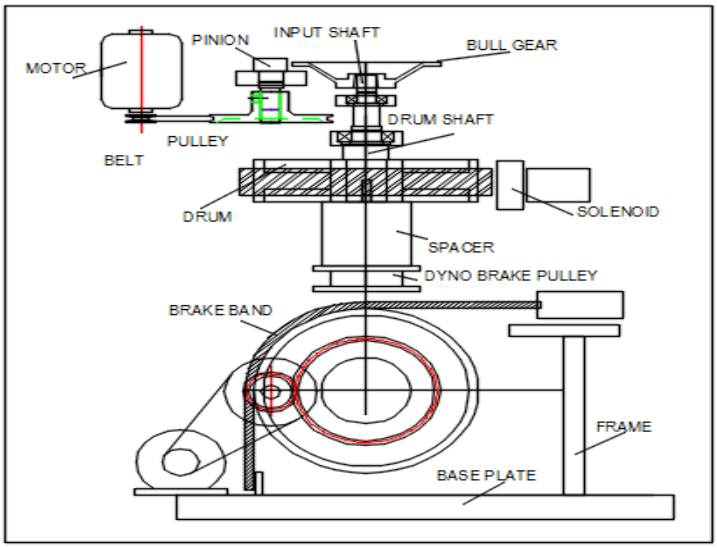
- Theoretical analysis of band brake liners.
- Performance of these liners at various loads and speed conditions by using Band brake Set up.
- The 3-D modeling of liners and friction and strength analysis of liners will be done by using ANSYS software.
- Comparative study of the theoretical braking force & brake-energy consumption through experimental brake dynamometer testing there by validation of experimental result to theoretical design.

- Best upon above comparative study selection of best alternative out of moulded and woven form non asbestos material

PROPOSED WORK / METHODOLOGY OF THE PROJECT



BAND BRAKE SET UP



CONCLUSION AND FUTURE TRENDS

Different non-asbestos friction materials have to be replaced with asbestos fibers as it can lodge in the lungs and induce adverse respiratory conditions. So the Environmental Protection Agency announced a proposed ban on asbestos. The ban would have required all new vehicles to have non-asbestos brakes. From this we can see that there are different frictions materials available which can be replace

by asbestos material. The different test conducted brake liner as per the specification & working condition as per the Europe regulation 90.After the test the characteristic, frictional coefficient, wear behavior is observed and according to that we will prepare the result. It gives lower emissions and fuel efficiency as environmental regulations become more stringent this shifts towards environment. The wear behavior of the brake liner is less so the life of liner is more. It gives lower emissions and fuel efficiency as per environmental regulations. It maintains the temperature of the drum & liner so it will not realize the hazardous material in the atmosphere.

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