Design and analysis of drum brake shoe lining by fea: a review

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***Abstract*- The drum brake is a mechanical device which inhibits motion by the concept of friction generate in a set of shoes or pads. Brake pads are the most important of automobile breaking system. It helps in smooth retardation of vehicle and finally bringing to halt. Brake pad converts vehicle kinetic energy into thermal energy by friction. So the analysis takes place on both the thermal stresses and mechanical stress. Generally, safety parts of cars and trucks are brakes, the common material are used for drum brake shoes is cast iron. A model is created with the help of software CATIA V5 and structural and thermal analysis are performed in ANSYS 16.0 work bench software. A static and thermal analysis of different materials such as aluminium alloy, aluminium metal matrix composite (1), aluminium metal matrix composite (2) and titanium alloy will be done. Steady state condition is studied for all the four materials. A comparison of all the four results is done and aluminum metal matrix composite (2) material is proved better than the other materials.**

***Keywords*: - drum brake shoe lining, static analysis, thermal analysis, ANSYS, CATIA.**

I. INTRODUCTION

Brake drum was invented by Louis Renault in 1902. He used woven asbestos lining for the brake drum lining as no alternative dissipated heat like the asbestos lining. The shoes in brake drums wear thinner, and brakes required regular adjustment until the introduction of self-adjusting brake drums in 1950's. Inside the drum and protected from internal cylindrical surface. A drum brake unit consists of two brake shoes mounted on a stationary backing plate. When the brake pedal is pressed, a mechanically activated wheel cylinder pushes the shoes out to contact a rotating drum which creates friction and slows the vehicle. As the pedal is released, return springs retract the shoes to their original position.

A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum shaped part called a brake drum. The brake drum is generally made of cast iron that rotates with the wheel. When a driver applies the brakes, the lining pushes radially against the inner surface of the drum, and the ensuing friction slows or stops rotation of the wheel and axle, and thus the vehicle. The general characteristics of automotive friction materials are summarized as follows. The friction level must be adequate and stable over a wide range of operating speeds, application pressures and temperatures, regardless of the conditioning and age of the material. Of particular interest are the fade-recovery characteristics, ***i.e.*** the ability to resist friction level deterioration when subjected to extreme elevated temperatures (the fade) and then to return to the pre-fade friction level on cooling (the recovery). The friction material must also have good wear properties for long life, but it must also not cause excessive wear or grooving on the mating disc or drum. Excessive compressibility, noise and roughness (chatter, vibration, pulsation) must be avoided for comfort, and sensitivity to moisture or water must be minimized. The friction material must be capable of being manufactured with consistency at a reasonable cost.

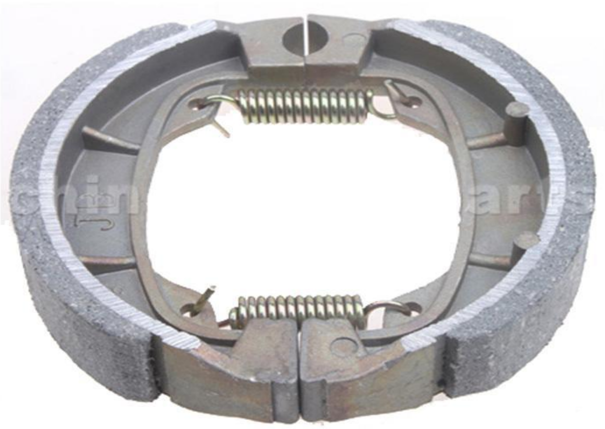

Fig: Drum Brake Shoe

II. LITERATURE REVIEW

Dvsrbm Subramanyam L.Sravan (1)

In this project design of the model of drum brake (drum, & pads) in solid works 2016 and structural and thermal analysis are performed in ansys work bench software. First structural analysis of pressure of 1.5 Mpa is applied with three different materials such as aluminum alloy, Carbon Steel, aluminum Metal matrix. From result we can conclude that beside general material, aluminum metal matrix (ks1275) which is economically less cost and less weight ratio gives nearly same stress and deformation value in static analysis and giving good thermal distribution value so it can also use as the material for drum brake beside general materials.

Nagesh S.N (2)

The brake pads were manufactured by using powder metallurgy techniques. The manufactured brake pads were tested for coefficient of friction, wear, shear strength, hardness and micro structural analysis. The various tests were compared with existing brake pads composition. Hard friction materials were found on brake pads wear at lower rates but results in high brake noise. Brake pads S2 and S4 showed results which were equivalent to existing brake pad.

M.A. Maleque (3)

The aim of this paper is to develop the material selection method and select the optimum material for the application of brake disc system emphasizing on the substitution of this cast iron by any other lightweight material. Two methods are introduced for the selection of materials, such as cost per unit property and digital logic methods. Material performance requirements were analyzed and alternative solutions were evaluated among cast iron,
aluminium alloy, titanium alloy, ceramics and composites. Mechanical properties including compressive strength, friction coefficient, wear resistance, thermal conductivity and specific gravity as well as cost, were used as the key parameters in the material selection stages. The analysis led to aluminium metal matrix composite as the most appropriate material for brake disc system.

J. Kukutschova (4)

A model semi-metallic brake lining was subjected to full-scale automotive brake dynamometer tests. The structural properties and surface topography of brake linings were analyzed at different stages of wear testing and correlated to frictional performance. Characteristics of released wear particles were also addressed. A combination of abrasive and adhesive wear with oxidative processes dominated the friction process. Formation of a friction layer adhering to the friction surfaces of pads and discs is the major feature responsible for friction performance. Wear debris generated during the dynamometer tests was collected from containers placed under the brake inside dynamometer chamber. The collected debris was compared with ball-milled particles from identical brake lining. Wear debris released during automotive brake dynamometer test has similar chemistry as friction layer detected on surface of brake lining. While wear debris generated in dynamometer was toxic (killing bacterial cells) after metabolic activation, the ball-milled samples “only” demonstrated potential mutagenicity, changing DNA of bacterial cells. Acute inflammatory response of bronchi and translocation of ball-milled particles to lymphatic tissue of rats was detected for particle fraction smaller than 5_m and for doses 3mg/1 ml instilled to rats.

Zmago Stadler (5)

This paper reports on the friction and wear properties of sintered metallic (MMC) brake linings, which appear to combine well with a C/C-SiC brake disc. The friction characteristics were examined with a dynamometer on two different commercial motorcycle brake systems, differing in terms of the brake caliper and the dimensions of the disc. The influence of the components, such as graphite, and the abrasives in the metallic matrix on the formation of the friction layer was investigated. Due to plastic deformation, resulting in mixing of the metallic phases and the consequent enhanced oxidation, a friction layer is formed, the addition of SiC increases the hardness of the base metallic lining by more than 50%, whereas its influence on the mean COF is less significant. Although graphite is a lubricant, it raises the COF of the lining by 10%, presumably due to the lower hardness, reflected in a larger actual contact area between the lining and the disk, increasing the COF.

Seong Jin Kim (6)
An experimental investigation was carried out to examine the tribological behavior of NAO (non-asbestos organic) type brake linings containing different volume ratios of graphite and antimony trisulfide (Sb2S3). A scale dynamometer was used for friction tests and particular emphases were given to the effect of applied pressure, sliding speed, and temperature on the coefficient of friction according to the relative amounts of the two solid lubricants. Results showed that the brake linings with both solid lubricants exhibited better friction stability and less speed sensitivity than the friction materials containing a single solid lubricant. In particular, the brake lining containing higher concentrations of graphite showed better fade resistance than others during high-temperature friction test. The brake linings with both solid lubricants were better in friction stability due to the complementary role of the two lubricants.

M.G. Jacko (7)
This paper describe the need to eliminate asbestos from friction materials, and the conversion of the heavy vehicles to more energy-efficient lighter and smaller front wheel drive vehicles. Until the late 196Os, the U.S. passenger car and light truck automotive market used drum brakes on all four wheels and asbestos-fiber-reinforced brake linings. Since the mid-1970s, research and development have been actively pursued for producing improved semimetallic and new asbestos-free friction materials which would be superior to asbestos-based friction materials.

III. CONCLUSION

From the above literature survey we find that there are many researchers done analysis on drum brake shoe lining and material taken by them are such as cast iron, aluminium alloy, aluminium metal matrix and composite materials.
The various factors such as: -Material is economically less strength by weight ratio, less weight, less deformation, minimum temperature at the surface, high coefficient of friction, High wear resistance and impact on environment on the brake liner is attributed to the higher temperature generated due to seizure between the brake drum shoe and the panel.
Then, I have decided that I will do the analysis of drum brake shoe lining by taking the materials such as aluminium metal matrix composite (1), (2) and titanium alloy and find out the total deformation, maximum stress, heat flux and maximum temperature.

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