A Paper Review on Scope of Non Asbestos and Natural Wastes Material

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Abstract— *Non asbestos materials have found wide applications in our daily life. There are some advantages in using particles reinforced AMCs materials than unreinforced materials such as- greater strength and high specific modulus, improved stiffness, light weight, low thermal expansion coefficient, high thermal conductivity, tailored electrical properties, increased wear resistance and improved damping capabilities. Now it is used in aerospace, thermal management areas, industrial products, automotive applications such as engine piston, brake disc etc.*

In this Paper, we have studied the scope and objective of non asbestos material to understand their process-structure–property relations by optimization process.

In this paper we have small discussion on scope of Non Asbestos Materials Replacement of conventional asbestos based friction materials has been called for because of bans on the use of asbestos. Research in this direction in the last decade has led to the development of more efficient asbestos-free friction materials for automobiles. Fiber reinforced polymers show great promise for applications in modern vehicles.

Keywords— Agricultural waste, Brake pad, Non asbestos, Scope, Silicon carbide.

I. INTRODUCTION

In the past few years the global need for low cost, high performance and good quality materials has caused a shift in research from monolithic to composite materials. Asbestos was once considered to be a ”miracle mineral”. This naturally occurring silicate has many desirable characteristics, including resistance to fire, heat, and corrosion. It is strong, durable and flexible. Asbestos is inexpensive because it is available in abundant quantities. Its versatility has led to its use as a component of a variety of products in numerous industries.

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 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

II. LITERATURE REVIEW

K.K. Ikpambese

Prepared brake pad material using natural fiber called palm kernel fibers (PKFs) for its eco friendly nature with CaCO3, graphite and Al2O3 as other constituents. Epoxy resin is used as binder. Composition of 40% epoxy-resin, 10% palm wastes, 6% Al2O3, 29% graphite, and 15% calcium carbonate gave better properties than other composition. The results were compared with commercial asbestos, palm kernel shells. Results shown that PKF can be suitable for replacement of asbestos brake pads with epoxy resin as a binder.

Tamer Ozben, Erol Kilickap, Orhan Cakır

In Investigation of mechanical and machinability properties of SiC particle reinforced Al-MMC article, The influence of reinforced ratios of 5, 10 and 15 wt.% of SiC-p on mechanical properties was examined. It was observed that increase of reinforcement element addition produced better mechanical properties such as impact toughness and hardness, but tensile strength showed different trend; increase due to 10 wt.% of SiC-p reinforced and then decreased when 15 wt.% of SiC-p reinforcement addition

C.M.Ruzaidi

Incorporated the waste material, palm slag as filler material along with CaCO3 and dolomite in brake pad material to increase the performance to cost ratio. The final composition is made using steel fibres, phenolic resin and other friction additives. Results shown that even though the dolomite brake pad composite had the highest

strength, it showed poor wear behavior compared to calcium carbonate and palm slag. Thermal stability of the palm slag material shown the better performance compared to other two filler material in the range of 50oC to 1000oC. It is proven that phenolic resin cannot be used at high temperatures since curing of binder starts at a temperature of 150oC caused for the weight loss

Ali Belhocine, Mostefa Bouchetara (2012)

Investigation of temperature and thermal stress in ventilated disc brake based on 3D thermo mechanical coupling model: The thermal behavior of the full and ventilated brake discs of the vehicles using computing code ANSYS. The modeling of the temperature distribution in the disc brake is used to identify all the factors, and the entering parameters concerned at the time of the braking operation such as the type of braking, the geometric design of the disc, and the used material.

Himanshu Kala, K.K.S Mer, SandeepKumar(2014)

A Review on Mechanical and Tribological Behaviors of Stir Cast Aluminum Matrix Composites. The above review for the stir cast aluminum based metal matrix composite leads to the following conclusions. Stir casting method can be successfully used to manufacture metal matrix composite with desired properties, Reinforcing Aluminum and its alloys with ceramics particles has shown an appreciable increase in its mechanical properties. Addition of alumina, SiC, B4C etc. particles in aluminum improves the hardness, yield strength, tensile strength while ductility is decreased. Addition of graphite in aluminum increases the tensile strength and elastic modulus but hardness is decreased. Also it shows a decrease in friction coefficient in case of tribological behavior. Organic reinforcements like coconut ash, rice husk ash also improved the mechanical properties of the aluminum along with the tribological behavior of the composite. For Al MMCs with organic reinforcements, very limited work has been reported. Organic reinforcement additions to aluminum matrix systems have shown significant increase in the mechanical properties of resulting composites. However, substantial improvement in the tribological properties has not been achieved in the limited reported literature in this area. This provides scope for further investigations in the field. A few authors have reported about modified stir casting methods for improving the distribution of the reinforcement in the matrix. However, there is a lack of work regarding availability of efficient techniques for nano level reinforcements. Hybrid ceramic reinforcement has increased the mechanical properties much but literature on tribological properties in case of hybrid reinforcement is limited

JohnyJames.S, Venkatesan.K,Kuppan. P, Ramanujam.R(2014)

Hybrid Aluminum Metal Matrix Composite Reinforced With SiC and TiB2; Micro structural analysis shows the presence of SiC and TiB2 and its distribution in the metal matrix. Increase in weight percentage of reinforcement (SiC10%&TiB25%) leads to cluster formation. Hence the maximum % of TiB2 into the matrix is limited to 2.5% for 10% SiC It has been concluded from hardness measurement that, addition of reinforcements has effect on hardness value, but addition of TiB2 up to 5% leads to porosity which affects hardness value. From tensile test results it has been observed that addition of reinforcement Sic to base metal added 20%strength to the composite but addition of TiB2 reduction in 50 -60% strength is recorded. It has been analyzed from micro structure study and from tensile specimen after experiment that cluster formation leads to porosity and porosity leads to reduction in strength than base aluminum alloy

P.B.Pawar1, Abhay A. Utpat(2014)

Development of Aluminum Based Silicon Carbide Particulate Metal Matrix Composite for Spur Gear; In this work a composite is developed by adding silicon carbide in Aluminum metal by mass ratio 2.5%, 5%, 7.5%and 10%. The composite is prepared by stir casting technique. Mechanical tests such as hardness test, microstructure test are conducted. It is proposed to use this material for power transmitting elements such as gears which are subjected to continuous loading. Finally modeling and finite element analysis of gear is done using CATIA and ANSYS 14.0. In case of increased silicon carbide content, the hardness, and material toughness are enhanced. From the results it is concluded that composite material such as aluminum silicon carbide is one of the option as a material for power transmission gears.

Akhilesh Jayakumar and Mahesh Rangaraj(2014)

Author had done Property Analysis of Aluminum (LM-25) Metal Matrix Composite. The investigation was on processing of SiC particles reinforced functionally graded Aluminum matrix composite cylinders and non-reinforced Aluminum cylinders by centrifugal casting to obtain the microstructure and mechanical properties for evaluation. Aluminum alloy (Al 356/LM 25) is used as matrix and SiC as reinforcement. Composite was primarily manufactured by liquid metal stir casting way. Centrifugally cast base composite and alloy cylinders have also been fabricated for structure and properties comparison. The micro structural features of the base alloy are similar both towards the outer and inner periphery, however the porosities are seen towards the inner periphery due to the separation of low density gas porosities. The size of the primary Aluminum and eutectic silicon phases are finer towards the outer margin due to the higher solidification rate. Microstructures of Functionally Graded Al-SiC Composite cylinder shows

the presence of higher volume fraction of SiC particles towards outer periphery, gradually decreases towards the inner periphery and the particle depleted zone is seen. The agglomerated particles are segregated towards the inner periphery due to the lower density of the particle agglomerates. These particle agglomerates are formed due to partially wetted particles related with voids and gas porosities. The higher volume fraction of particles is seen at the outer periphery of the composite cylinder. The surface closer to the outer periphery (0-10mm) shows lower volume fraction due to the chill zone formation. The functionally graded composite cylinder shows higher hardness towards the outer periphery, due to the presence of high volume fraction of silicon carbide particles.

IDris et-al

Produced a new brake pad using banana peels waste to replaced asbestos and phenolic resin as a binder was investigated. The resin was varying from 5 to 30 wt% with interval of 5 wt%. Morphology, physical, mechanical and wear properties of the brake pad were studied. The results shown that compressive strength, hardness and specific gravity of the produced samples were seen to be increasing with increased in wt% resin addition, while the oil soak, water soak, wear rate and percentage charred decreased as wt% resin increased. The samples, containing 25 wt% in uncarbonized banana peels (BUNCp) and 30 wt% carbonized (BCp) gave the better properties in all. The result of this research indicates that banana peels particles can be effectively used as a replacement for asbestos in brake pad manufacture

Summary of literature review:

- Disc brakes are used most commonly in braking system. Due to repetitive breaking the temperature of pad and disc goes on increasing which leads to failure of brake system and brake fading
- The maximum surface temperature obtained for brake disc goes up to 200–250^{O}C and for brake pad goes up to 800–900^{O}C
- From literature survey it mainly reveals that less work is carried on Al composite at elevated temperature
- In most of experimental work stir casting technique is used to manufacture the composite. Much work is carried on dissimilar series of Al alloy with various percentage of reinforcement of SiC particles
- According to the literature review, precise control of the Al–SiC interface is the first key parameter to achieve improved mechanical properties. Hardness of Al-SiC is much better than the aluminum metal. In case of increased silicon carbide content, the hardness, and material toughness are enhanced and highest value is obtained at 10% SiC content.
- More uniform distribution of SiC particles can be found if composite is prepared by powder metallurgy than stir casting;

III. SCOPE AND OBJECTIVE OF RESEARCH

Scope

Nowadays, finding ways to develop new structural materials with higher strength to weight ratios is one of the biggest challenges in the transportation and aerospace industry. Properties like high specific strength, stiffness, better wear resistance and improved elevated temperature properties compared to the conventional metals and alloys are the key reasons for the increasing attention towards Metal Matrix Composites (MMCs). A variety of processing ways have been established for the production of particle/whisker/short fiber reinforced composites. Stir casting and powder metallurgy are the most universally used approaches to manufacture particle reinforced composites; also it is essential to find best suitable method for the material which has good mechanical properties.

The scope of research will include developing mathematical model for profile and shaping development of the lining so as to determine geometrical dimensions of lining to absorb determined brake power

Coconut Waste

Objectives

The main aim of this project is to check feasibility of the Aluminium based silicon carbide metal matrix composite by different manufacturing processes for vehicle braking pad. The main objectives of this project are listed below:

- To study the different methodology of manufacturing of the MMC.
- arranging the matrix and reinforcement materials ,controlling the processing atmosphere and preparing composite by stir casting technique and powder metallurgy
- To evaluate the mechanical properties of the MMC prepared by stir casting and powder metallurgy.
- To find out optimized percentage of Sic as reinforcement material.
- To determine the best alternative manufacturing process to give required properties.
- To do Scanning Electron Microscopy (SEM) of samples.

Example 1

Preparation of the Brake pad composite:

Once the chemical treatment and mechanical treatment for raw materials is over, the final composition is made with other ingredients like filler, fiber, binder, frictional additives etc in different formulations. Each formulation is mixed to obtain a homogeneous mixture of ingredients. Then, the mixtures are compacted at a pressure of 15-17 MPa using a unaxial, hydraulic hand press machine for the green body of the brake pad composite Then, the green body was compacted further and cured using a hot press at 150 °C with 60 tons of compressive molding pressure for five minutes. At the end of the hot-pressing process, samples were taken out of the molds, allowed to cool to room temperature, and cured further at a constant temperature of 150 °C in air oven for four hours.

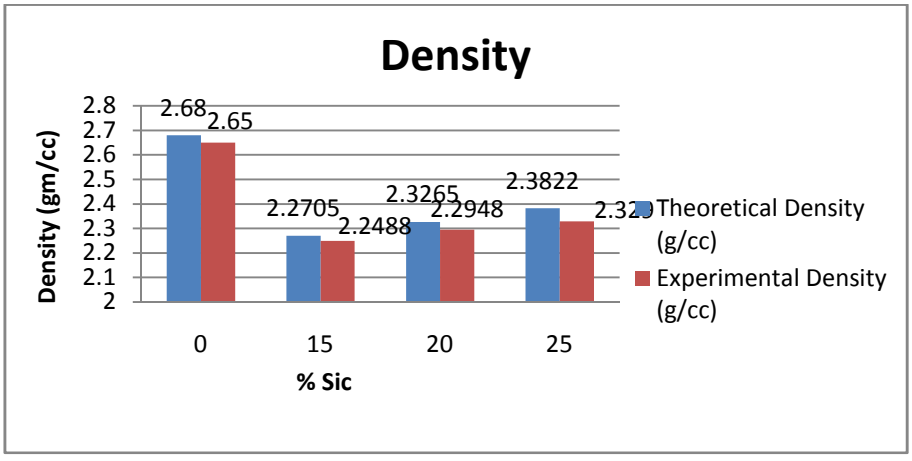
Testing and Analysis:

The mechanical properties of phenolic resin based brake pad composites were determined by a universal testing machine (UTM) at room temperature. Each sample, consisting of an initial cross-sectional area of 86.6 mm², was placed between the lower cross member and lower friction composite samples were obtained using a digital Rockwell hardness tester. A sample with a diameter of 10 mm was used to carry out the test at different filler. The test was conducted using a 1/8-inch-diameter steel ball indenter with a load of 100 kgf. Brake pad test rig was used to determine the pads wear, disk temperature rise and disk stopping time. Figure 2 shows the schematic diagram of the brake pad test rig. It has a 2.2kW motor with a provision for speed variation by using a stepped pulley. The motor provides the energy required to set the flywheel weights and the brake disc in angular motion. When a set of brake pad is fixed into the brake caliper assembly of the test rig, the system is switch-on and the drive shaft begins to rotate, it is then allowed to attain a desired speed. Thereafter, a manual force is applied on the brake pedal which is similar to that of a motor car. Subsequently the stopping time, temperature of the disc and brake pad material lost are recorded. The speed and brake line pressure ranges were: 6.66 m/s to 13.82 m/s and 0.2 – 0.6 MPa respectively for the test conditions.

IV. RESULTS AND DISCUSSION

A density measurement test has been carried out on a laboratory scale to examine the density of the material after sintering. Density is depends upon the ingredients in the pad material. A metallic element will have a higher density than an organic element. Friction elements often exist in combination of various elements.

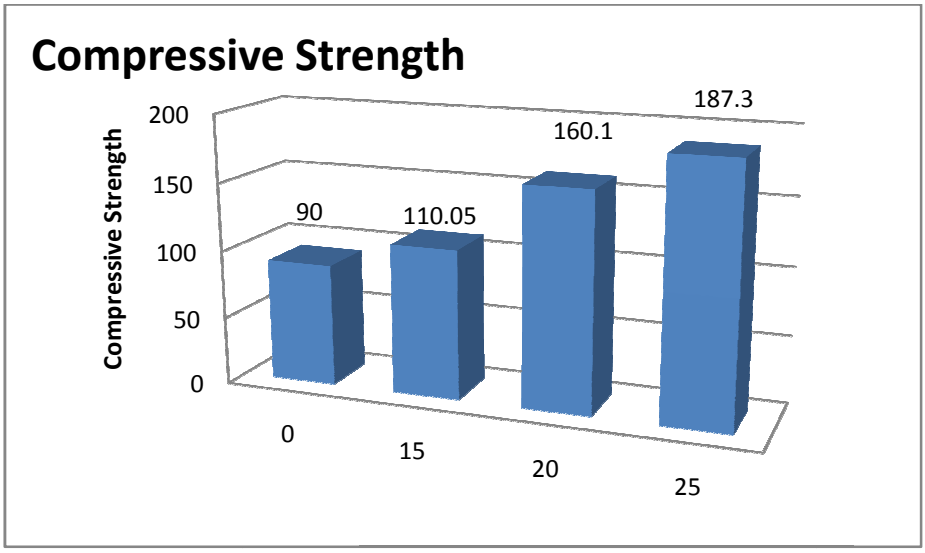
Theoretical density decreases with increasing quantity of reinforcement material. Gr 1 shows that the decrement in the theoretical density. Theoretical density is slightly greater than the experimental density.



Gr.1 Density Comparison with Sic

It has been observed that, there is no major change in the porosity by increasing amount of SiC. Because of compaction is performed at constant load. Due to less porosity we get better mechanical properties like Density, Hardness, Tensile strength, Compressive strength

Compressive Strength



Gr 4 Compressive Strength variation with Sic

From Gr.5 it has been observed that, with addition of Sic, tensile strength increases up to 20-22% without changing density of material which is desirable for light weight material but after exceeding certain value, it decreases.

V. CONCLUSION

In this review paper different agricultural wastes are studied as alternative for asbestos brake pads. The results are shown that the performance is almost equal to asbestos brake pads without any environment and health effects. For having better physical properties, brake pads with coconut fibers are studied and their composition percentage is optimized. This paper is review about the various engineering aspects of the composite brake lining materials considering their nature, behaviour and properties.

- ✓ Increasing the percentage of phenolic resin to the composition made up of banana peels increases tribological properties but excessive addition causes poor shelf life, evolution of noxious volatiles etc. Alternatives for phenolic resins like newly developed resin, epoxy resin etc are studied.
- ✓ Theoretical density is slightly different that experimental density
- ✓ With proper dispersion of SiC there is an measurable increment in compressive strength without increase in brittleness. This is desirable for light weight material.

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