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FABRICATION AND TESTING OF BRAKE PADS USING COMPOSITE MATERIALS

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1.ABSTRACT :

The manufacturing and evaluation of brake pads employing composite materials as an alternative to traditional asbestos-based ones will be the main emphasis of this project. In its many forms—epoxy resins, fibres, and so on—composite material offers environmental durability or heat resistance without posing a risk of asbestos exposure. To get the best mechanical strength, the forming process incorporates a moulding step within a regulated curing period. In accordance with industry testing requirements, these manufactured brake pads are put through routine tests to assess their thermal stability, friction coefficient, and wear resistance. Based on the results, performance improvement, cost-effectiveness, and sustainability are then assessed, highlighting the potential of composite materials in automotive braking systems.

2. INTRODUCTION :

In this manner, friction through the brake pads transforms the vehicle's kinetic energy into thermal energy. The brake caliper has two brake pads, each of which faces the rotor on its friction surface.

It squeezes the two brake pads onto the rotating rotor through calipers when the brakes are hydraulically applied. When a brake pad is heated by contacting the rotor, it transfers minute quantities of its friction material to the disc, leaving a depressing grey coating behind. Now, with the friction material on it, the brake pad and disc "stick" to each other to create the friction that slows the car down. Each disc brake rotor is equipped with two brake pads. They are held and actuated by the caliper, which is bolted to the wheel hub or suspension upright. Most car brakes utilize two pads per caliper. Racing calipers may have up to six pads in a staggered setup with different frictional values for optimal performance. The wear rates of discs may also differ depending on material behavior. Brake fade can only be avoided if brake pads are replaced at certain intervals, depending on pad material. Most of the brake pads have an inbuilt system that warns the driver when this needs to be done. One common way is to mold a small center groove that, when worn away, indicates the end of a pad's service life. The others involve either embedding a soft metal tab in the pad material that cuts an electric circuit and lights a dashboard warning light as the brake pad wears down, or inserting a thin strip of soft metal in a groove so that when exposed — due to wear — the brakes screech audibly.

3. Literature Survey

Literature survey is the most important part of dissertation work. It gives the idea of various works carried out so far in the related field of composite material for brake pads.
Following are some of the related literature survey which is considered for conducting the research work.

➢ K.K. Ikpambese et-al [1] Because it is environmentally beneficial, the premade brake pad material uses natural fibers called palm kernel fibers (PKFs), along with additional ingredients including graphite, Al_2O_3, and $CaCO_3$. The binder is epoxy resin. Compared to other compositions, the 40% epoxy-resin, 10% palm waste, 6% Al_2O_3, 29% graphite, and 15% calcium carbonate composition had superior characteristics. The outcomes were contrasted with palm kernel shells and commercial asbestos. The findings indicated that PKF would be suitable for using epoxy resin as a binder in place of asbestos brake pads.

➢ C.M.Ruzaidi et-al[2] incorporated the waste material, palm slag as filler material along with $CaCO_3$ and The performance to cost ratio would rise if dolomite were added to the brake pad composition. Steel fibers, phenolic resin, and other friction additives are used to create the finished composition.

According to the results, the dolomite brake pad composite was the strongest, but it did not wear as well as calcium carbonate and palm slag. In the 50°C to 1000°C temperature range, the palm slag material's thermal stability performed better than that of the other two filler materials.
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.

➢ IDris et al. [3] created a new brake pad by using banana peel waste instead of asbestos and researching the usage of phenolic resin as a binder. With a 5-weight-percent interval, the resin ranged from 5 to 30 weight percent. The brake pad's morphology, mechanical characteristics, and wear characteristics were investigated. The findings showed that while the samples' compressive strength, hardness, and specific gravity improved with the weight percentage of resin added, the percentage of charred material, wear rate, water soak, and oil soak all decreased. Samples with 25 weight percent uncarbonized banana peels (BUNCP) and 30 weight percent carbonized banana peels (BCP) had superior overall qualities. According to the research's findings, particles from banana peels could be a great substitute for asbestos.

4.OBJECTIVE :

Organic-based composites, which are typically made of fibers, fillers, and resin, promise to lessen environmental impact, improve brake efficiency, and minimize wear. The following provides a detailed description of the study's goals.

I. Development of Organic-Based Composite Material
Selection of raw materials: Choose organic fibers (such as natural fibers, aramid, or cellulose), resins, and other additives (e.g., fillers, plasticizers) that provide the necessary mechanical properties on the brake pad performance.

II. Fabrication of The Brake Pads •
Molding and shaping: Develop suitable techniques for molding on the brake pad into desired shapes and dimensions while ensuring consistency in material distribution.

III. Mechanical Property Testing
Compression strength: Test the compressive strength for the brake pad of materials to determine its ability to be withstand the forces exerted during braking.

5.Components of the project :

1. Coconut shell

Powdered coconut shell is often utilized as a filler in composite brake shoes, where it may help achieve certain desirable qualities like sustainability, affordability, and wear resistance.

2. Ceramic Brake Pads

Ceramic can find a small amount of metal in this brake pad type, but they are mainly made of ceramic fibres, bonding agents, and nonferrous filler materials. They create less noise, wear down slowly in comparison to other brake pad types, and create less dust. They were developed after semi-metallic pads in an attempt to reduce noise, heat, and brake dust.

3. Non-Asbestos Organic Brake Pads

Organic brake pads very peculiar properties than that of the others. Advantages are more than the drawbacks. Not asbestos This type of brake pad is manufactured using filler materials and high temperature resins to create organic fibers. They are softer and make less noise than the semi-metallic kind, but they decay more quickly and produce more dust. Non-Asbestos Organic brake pads have the advantages of being inexpensive and silent, but they also have the drawback of wearing out quickly due to the use of organic additives in their construction.

4. Steel Slag

Due to its resource-conserving and energy-saving properties, steel slag and iron recycled material that can lessen the consequences are highly valued as a result of increased environmental consciousness. Because of their excellent frictional and abrasion resistance and comparatively high binding strength, steel slags are utilised as coarse aggregates in pavement bases and sub bases.

4. Aluminium Oxide

Alumina is often used in industrial applications which are odourless and white amorphous material. Its outstanding properties has contributed in society enhancing applications such brake lining materials, brake pad and brake shoe materials etc.,

5. Graphite Powder

One of the elements' naturally occurring forms is graphite, which is mostly found in the carbon form. Despite its superior mechanical and thermal qualities, it is still utilized in lubricants.

7. RESULTS & CONCLUSION :

The current study has assessed the wear and friction behavior of the recently created brake pad material under three distinct situations using nine distinct composites of epoxy resin and coconut shell powder.

The important conclusion resulted from the above study are as follows:

a) An increase in the coefficient of friction was the result of the coconut shell powder properly adhering.
b) The more coconut and epoxy resin samples there are in the brake pad samples, the higher the coefficient of friction.
c) The wear rate for the brake pad sample is decreasing with increasing in weight percentage of coconut and composite materials.
d) Weight density has been decreases with the increase in weight percentage of coconut and composite materials.

8. TESTING AND CALCULATION :

Wear Tests TESTING AND CALCULATION Setting up the test apparatus:

1. Clean the specimen pin with fine-grade emery paper and remove any burns from its circumference.
2. Weight the specimen on a high-precision weighing scale with a minimum count of 0.01 mg to obtain its weight accurately

6. METHODOLOGY :

1. Coconut shell powder could be utilized as a filler in composite materials for brake shoes, offering the desired qualities of environmental sustainability, wear resistance, and economic viability.
2. Basalt fiber: Is material made by extraction of fibers form basalt. The basalt rock is crushed, washed, and melted at 15000C.
3. Steel slag: Raw powder has been purchased from the market which has the silicates and oxides as its composition which is playing vital role in increasing
4. Aluminium oxide: Is an inert, odourless, white amorphous powder which is generally used making industrial ceramics.
5. Graphite: Is crystalline allotrope of carbon. It is most stable form carbon. It is conductor of heat and electricity.

9. ASSEMBLY OF THE PHYSICAL PROTOTYPE.

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