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Experimental Investigation of Brake Pads using Composite Materials

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Abstract: *This research focuses on identifying the ideal material composition to achieve the best balance of hardness and wear resistance. The experimental approach involved utilizing a specialized test bed to evaluate the mechanical properties of different material formulations. During the tests, material specimens were carefully weighed both before and after the testing process to calculate the wear rate by measuring the change in mass. The experimental results revealed that a 50:50 composition outperformed the 60:40 composition in terms of hardness and wear resistance. This superior performance indicates that the 50:50 composition offers a better balance of strength and durability, making it more suitable for applications that require both properties. These findings are particularly significant for industries like manufacturing, materials engineering, and automotive production, where material performance directly impacts the efficiency and longevity of the final products. By highlighting the advantages of the 50:50 composition, this study contributes valuable insights into the material selection process, enabling engineers and designers to make informed decisions that improve the overall performance of their applications.*

Keywords: Material composition, Hardness, Wear resistance,50:50 composition, 60:40composition Experimental approach, Test bed, Wear rate measurement, Mass change, Mechanical properties, Material performance, Manufacturing, Materials engineering, Automotive production, Durability, Strength and durability

I. INTRODUCTION

This project explores the development of eco-friendly composite brake pads using natural fibres and bio-resins . By evaluating there performance in term of friction , wear resistance and thermal stability the research aims to create sustainable alternatives to traditional brake pads, reducing environmental impact while maintaining high safety and durability standards.

This project investigates bio-composite brake pads made from natural fibers and bio-based resins. Through testing under various conditions, including high temperatures and wear, the research aims to evaluate their durability, friction, and thermal stability. The goal is to provide a sustainable, cost-effective alternative to traditional brake pad materials .Brake system technology is evolving to improve safety, performance, and sustainability, with a focus on non-asbestos materials due to the health risks posed by asbestos brake linings. Corn cobs, an underutilized agricultural by-product, are being explored as a potential raw material for eco-friendly brake linings, offering improved performance while addressing environmental concerns. Composite materials in brake linings improve strength, durability, and performance. Methods like compaction, compression, and direct pouring are used to create high-quality materials that enhance efficiency and longevity in automotive applications. Eco-friendly bio-composite brake pads offer sustainability, health benefits, waste reduction, and cost efficiency in automotive manufacturing. Bio-composite brake pads reduce emissions, energy use, and promote sustainability

II. LITERATURE REVIEW

As the automotive industry increasingly turns its attention to sustainability, the development of ecofriendly materials has become a significant focus. One area that has garnered substantial research interest is the integration of natural fibers into automotive brake pads. Natural fiber-reinforced composites present an innovative solution to the

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environmental and performance challenges posed by traditional brake pad materials, which often contain non-renewable resources and hazardous substances. Natural fibers, derived from renewable agricultural sources, offer numerous benefits such as renewability, biodegradability, low cost, and the potential to enhance the mechanical properties of brake pads. These characteristics make them an attractive alternative to the synthetic materials commonly used in the production of automotive components. Natural fibers like jute, hemp, flax, sisal, and coconut husk are used in brake pads for their strength, durability, and sustainability. These fibers offer benefits such as improved mechanical properties, wear resistance, thermal stability, and biodegradability, making them ideal for eco-friendly brake pads and reducing the environmental impact of automotive manufacturing. Natural fiber composites offer significant improvements in brake pad performance, addressing key factors like wear resistance, frictional properties, and thermal stability. These fibers, including hemp, flax, sisal, and coconut husk, enhance strength-to-weight ratios, allowing for efficient braking without compromising vehicle fuel efficiency

Examples of Natural Fiber Performance in Brake Pads:

Coconut Husk: Coconut husk fibers improve wear resistance and thermal stability due to their high lignocellulosic content. They enhance heat dissipation, prevent overheating, and reduce brake fade, maintaining consistent braking performance.

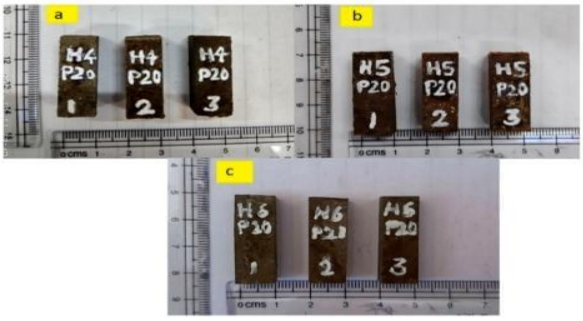
Hemp : These fibers offer high strength, stiffness, and lightweight properties. They contribute to enhanced mechanical properties, thermal stability, and wear resistance, making them ideal for high-performance brake pads under extreme conditions.

III. LITERATURE GAP

A literature gap exists in assessing the long-term performance of bio-composite brake pads, particularly regarding wear resistance, thermal stability, and durability under real-world automotive conditions. While existing studies explore the mechanical properties of bio-composites, there is insufficient research on their performance over extended use, especially under high-stress environments. Furthermore, the economic feasibility and scalability of producing bio-composite brake pads at a commercial level remain underexplored, necessitating more experimental investigations.

IV. METHODOLOGY

The methodology for the experimental investigation of brake pads using bio-composite materials involves several key steps. First, bio-composite materials such as hemp, flax, or coconut husk fibers are selected and combined with bio-based resins to create composite brake pads. Next, the prepared brake pads are subjected to mechanical testing, including wear, friction, and thermal stability tests, using standardized equipment. The samples are then analyzed for performance characteristics such as strength-to-weight ratio, durability, and heat dissipation.



V. CONCLUSION

The experimental investigation of brake pads using bio-composite materials demonstrates significant potential for enhancing automotive brake performance while promoting sustainability. The results indicate that bio-composites, such as those made from hemp, flax, and coconut husk fibers, offer comparable or even superior mechanical properties—such as wear resistance, thermal stability, and frictional performance—compared to traditional materials. Moreover,

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these bio-composites are environmentally friendly, biodegradable, and cost-effective, contributing to reduced environmental impact and waste

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