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# Asbestos-Free Aluminium Dross Brake Pad: A Mini Review

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## Abstract-

Asbestos-related materials are avoided due to cancer-causing asbestosis that is a health risk to users. A brake pad that is eco-friendly with the use of aluminium dross industrial waste and epoxy binder is therefore proposed. Various applications of aluminium dross have been explored by researchers with the view of reducing hazardous waste from the environment. Compressive strength, hardness, specific gravity, microstructural analysis, flame resistance, oil, and water absorption, and wear characteristics are significant tests carried out on the brake pad. Waste materials such as banana peel, bagasse, periwinkle shell, palm kernel shell, amongst others, were employed as common additives in the production of the brake pad. Exploring utilizing industrial and agro-waste in the development of a viable brake pad as an alternative to the existing brake pad is therefore reviewed.

**Keywords:** asbestosis, brake pad, compressive strength, flame resistance, industrial waste

## 1. Introduction

A brake pad is a component of a wheel in a vehicle that reduce or halt motion by converting kinetic energy to thermal energy in the form of heat through friction [1,2]. The brake pad is a composite of different materials with distinct, desirable properties. The properties should solve challenges from wear during the application, porosity during moisture penetration from rain or muddy area, improved hardness, and an absence of brittleness. Proper material selection for optimum performance of the brake pad is therefore necessary. The combination of materials for the brake pad should not pose a health risk to the environment during heat dissipation. The brake pad is composed of binder, powdered base material, fibre additive, and metal filings. These materials are pulverized and are shaped into a prepared mould at a temperature that can withstand wear [3-6].

Fibres employed in the production of brake pad are either synthetic or natural [4-6]. Synthetic fibre is quite expensive and is on watch for environmental risk. Examples of synthetic fibres are not limited to nylon, olefin, acrylic, aramid, polyester, rayon, and polylactide (P.L.A.). Natural fibres are not limited to bamboo, cotton, hemp, jute, kenaf, raffia, sisal, wool, camel hair, hair, wood, spider silk, and asbestos. With regulations to minimize environmental risk, natural fibres are explored for mechanical and improved tribological characteristics to replace the synthetic fibre [7-12].

The purpose of this review is to explore various materials employed for the production of brake pad and to recommend alternative and available industrial and agricultural wastes to be employed as a brake pad. The development of an optimum brake pad is necessary, and the reduction of waste in the environment is vital in ensuring a sustainable and eco-friendly world.

## 2. Asbestos Exposure and Health Hazard

Asbestos, among the natural fibre stands alone as mineral fibre, is spotted as a potential health risk to users and the environment. There has been protracted research on the probable hazard posed by the use of asbestos. [13] reported that workers that handle the box of brake



pad have more exposure to the risk of asbestosis compared to brake shoes. The risk is dependent on the duration of exposure to brake pads and shoes surrounded by airborne asbestos. [14] cleared the air that asbestos risk is associated with exposure to it, such as workers in asbestos textile and paper industry. The Naval community also downplay the noised health hazard posed by asbestos on brakes, gasket, and Bakelite, showing that the department working with these materials don't have sufficient exposure time compared to the workers in industries that are much exposed to asbestos [15]. A similar divergent view on the health hazard on asbestos is presented by [16] having insufficient information on its hazards in asbestos-related products such as brake lining, hygiene products, and automotive friction material.

### **3. Material alternatives to asbestos for Brake pad**

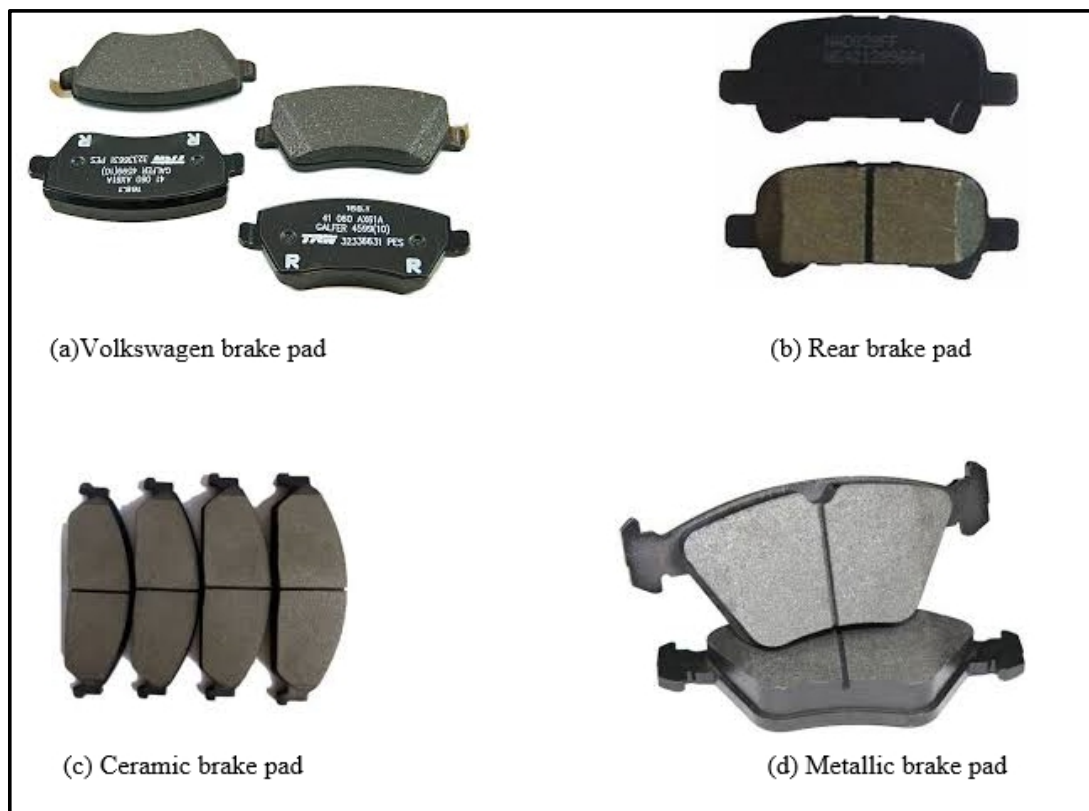
Asbestos is viewed as a safety material for humans in fire protection and employed in most products for humans, such as brake lining, brake pad, asbestos ceiling, and hygiene products, amongst others. Asbestos is of six types, which are chrysotile, actinolite, amosite, anthophyllite, crocidolite, and tremolite [17-19]. All asbestos is fibrous and possesses its associated risk. Asbestos poses a health risk for those continually exposed to it [20]. Health hazards from asbestos are asbestosis, asbestos corns, mesothelioma, and lung cancer [21]. The World Health Organization (WHO) presented an estimate of 125 million that are exposed to asbestos at the workplace, with 107,000 deaths from asbestos-related hazards. Alternative material that can function as a fibre is now well researched to minimize health threats to the environment [22-26]. Non-asbestos brake pads are now developed such as copper-aluminium alloy [27], cashew friction dust [28], palm kernel shell [29], bagasse [30], banana peels [31], maize husk [32], palm kernel fibres [33], periwinkle shell [34,35] sisal fibre [36]. The peculiarities of each material used as a replacement to asbestos is discussed by

[37] Figures 1: Brake Pad Types [38-40]

The production of the brake pad should possess not less than the following attributes abrasives, friction modifiers, fillers and reinforcements, and binder materials [41]. Materials employed in the production of brake pad are aluminium, silicon carbide, coconut fibre, graphite, alumina oxide, zirconia oxide, phenolic resin [42]. [43] used the following as materials for brake pad which are asbestos fibre, Metal fiber–steel fibre, Friction modifiers–brass, cashew dust, Solid lubricant–graphite (C), Abrasive–zircon ( $ZrSiO_4$ ), binder- phenolic resin, Styrene-butadiene rubber (S.B.R.) and Fillers, reinforcements. [44,45] showed that  $CaCO_3$  and  $BaSO_4$  could be used as fillers. Commercial Brake Pad (C.B.P.) consists of the following materials steel wool, natural graphite, carbon black, resin, ceramic fibre, and vermiculite. C.B.P. was partially replaced with artificial graphite, iron oxide, barytes and mineral fibre [46,47].

#### 4. Brake pad properties

In investigating the properties of brake pad, it is necessary to examine the properties of materials as it relates to its application. The durability of the brake pad is dependent on wear resistance and non-corrosive to the brake disc that is mainly metallic in composition. The material should be brittle-free else there is likely automotive brake failure during motion. [48] combined phenolic resin, palm slag, graphite, steel fibre and alumina to produce brake pad. the compressive strength, wear behaviour and hardness was investigated. Palm slag was mainly used as an alternative to other fillers used in brake pad production. A compressive strength of 58 MPa, wear rate  $0.89 \text{ m}^3/\text{m} \times 10^{-12}$  for 60 tons palm slag brake pad composite



was achieved by. The wear rate is slightly higher than asbestos brake pad at  $0.72 \text{ m}^3/\text{m} \times 10^{-12}$  [49]. Brake pad was developed by [50-53] by combining printed circuit board waste, palm

ash, phenolic and aluminium at different percentages. The result showed that the compressive strength improved when the percentage content of palm ash was increased. The high value of palm ash in the composite improved the wear property and lowers the water absorption. In an alternative filler employed for brake pad production by [54,55], dolomite (90 MPa) proved to have a better compressive strength than palm ash (58 MPa) and  $\text{CaCO}_3$  (79 MPa). Contrarily, palm ash had better hardness value than dolomite and  $\text{CaCO}_3$ .

Industrial and agrowaste exist that can be further explored as materials for brake pad. Chip from milling operation or residue from production process can be delved into for useful products. Examples among many are aluminium slag, iron slag, aluminium dross, scrap lumber, coconut shell, coconut fibre, oil bean stalk are available to be explored for brake pad production [56-60].

## 5. Conclusion

Asbestos is a potential risk to those exposed to it on a long term duration. Less risk is likely for auto mechanics and automobile users. There still exist eco-friendly raw materials in the environment that can be explored for the development of brake pad and other viable products. The utilization of these materials will reduce indiscriminate occupying of land space, energy demand during production process and the cost of production of brake pad and other cognate products. Further entrepreneurial window will be opened and probable reduction in unemployment index is envisaged.

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