REVIEW OF DEVELOPMENT OF BRAKE PADS USING SAWDUST COMPOSITE

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Abstract
This paper provides analysis of the manufacture of asbestos-free brake pads using wood sieve. Reducing the utilization of asbestos that has cancer dirt was practiced. The wood was sieved into sieve grades of a 100, 280, 355μm and one millimeter. The sieve wood was employed in the manufacture of brake pads compression moulding within the magnitude relation of 20% resin, 10% graphite, 15% steel, 35-55% wood and 0-20% silicon inorganic compound. The studied material properties embody microstructure, hardness, compressive strength, density, flames resistance, water absorption. The microstructure displays uniform distribution of resin within the wood. The results obtained showed that the stronger the materials, the finer the sieve capability. The results obtained during this study is the comparison of industrial brake pads.

Keywords: Sawdust Composite, Brake Pads, Kinetic Energy.

INTRODUCTION
Brake pads are the parts of disc brakes employed in vehicles. These are steel backing plates of friction elements connected to the floor-facing brake disc. Brake pads are employed in the braking systems to control the vehicle speed by changing the Kinetic Energy of the engine into thermal energy by friction and by dissipating the warmth made for the climate.

Brake pads are a unit typically made of asbestos-resin, at the side of many different elements. This traction material asbestos utilization had been prohibited in countries like US, UK, Japan, China etc., as a result of its risk of inflicting cancer to producing staff and end-users. Consequently, numerous experiments were on to seek out human-friendly content substitutes for elements of asbestos. Amphibole constituents in lining pad composites confer enticing high friction property that the machine pads can operate properly as motion stoppers. Brake pads, equipped with brake discs, are vital elements of the braking system for all vehicle varieties.

There are two styles of brake pads: Drum brakes and disc brakes. The drum brakes are mounted within a drum in order that once the brakes are applied, the lining is pushed outward and made against the wall. The disk brakes comprised of two brake pads and a rotor. Once the brakes are applied, the two pads lock off against the piston.

In the field of asbestos-free brake pad process, tons of labor has to be done.

EXPERIMENTAL MATERIALS USED IN THE RESEARCH PAPER
PAPER: Z.U. Elakhame, Y.O. Abiodun, N.A. Alausa, O.J. Omowunmi, A.O. Komolafe, Y.J. Obu: Manufacture of Automotive Brake Pads from Sawdust Composites, International Journal of Scientific & Engineering Research Volume 8, Issue 8, August-2017
The materials used are: Phenolic resin, phenol formaldehyde, sawdust, steel dust, silicon carbide, graphite with compositional analysis and photo as shown in Figure 1.

Properties of Raw Materials:
SAWDUST:
1. It has a density roughly about 500 – 1500kg/m³
2. Thermal conductivity varies from 0.369 – 1.01W/mK
3. Crushing strength of 4 – 14N/mm²
4. Modulus of Elasticity is about 2 – 2.5KN/mm²

STEEL FIBRE:
1. Tensile strength is between 90 – 130Kg/mm²
2. Acetone extraction is about 0.15% max.
3. Specific gravity is about 7.5 – 7.95
4. Density is about 0.83 – 1.15gm/cc

SILICON CARBIDE:
1. Density is about 3.02g/cm³
2. Maximum service temperature is 1380°C
3. Thermal conductivity is about 45W/mK
4. Bending strength is about 250MPa

GRAPHITE:
1. Thermal conductivity varies from 25 – 470W/mK
2. Specific heat capacity is about 710 – 8130J/mK
3. Modulus of elasticity is about 0 – 150GPa
4. Compressive strength is roughly about 20 – 200MPa

EPOXY RESIN:
1. Density is 1.16g.cm⁻³
2. Modulus of elasticity is 5GPa
3. Heat distortion temperature is 50°C
4. Tensile strength is about 90 – 120MPa

Raw Material Preparation

The wood was dried for concerning one month in sun. The dried wood was processed into powder, then aperture one millimetre, 355μm, 280μm and 100μm were sieved into totally different sizes. The samples were created employing a moulding press for compression. The counter mould was used for compression moulding to cover the mould till it absolutely was inseminated. Specific composition and sieve grades of wood powder, carbide, graphite, steel dust, and phenolic resin (i.e. 1 cm, 355μm, 280μm and 100μm) were applied along within the quantitative relation shown below.

| S. NO | MATERIALS  | A  | B  |
|-------|------------|----|----|
| 1     | Sawdust    | 35 | 40 |
| 2     | Steel Dust | 20 | 20 |
| 3     | SiC        | 20 | 15 |
| 4     | Graphite   | 10 | 10 |
| 5     | Epoxy Resin| 20 | 20 |

The mixture was properly mingling during a mixer to succeed in an even condition and touched to a mould control during a hot plate press at a temperature of 180°C at a pressure of 1160KN/cm² for two minutes. Upon unleash from the new press, the brake pad was cured in an oven at a temperature of 120°C for eight hours.

Elemental Composition analysis of sawdust particles

| S. NO | PARAMETER | LEVEL OF DETECTION (%) |
|-------|-----------|------------------------|
| 1     | SiO₂      | 0.021                  |
| 2     | Al₂O₃     | 0.062                  |
| 3     | Fe₂O₃     | 0.008                  |
| 4     | CaO       | 0.215                  |
| 5     | MgO       | 0.031                  |
| 6     | Na₂O      | 0.832                  |
| 7     | K₂O       | 0.543                  |
| 8     | MnO       | 0.006                  |
| 9     | Moisture  | 0.002                  |
| 10    | LOI       | 97.153                 |

Microstructure Analysis

The study of the fabric microstructure was allotted by grinding the samples exploitation three hundred, four hundred and 600 grit sheets, severally. Dry spraying was then done on those samples, and also the internal structures beneath the magnifier were given beneath the processed metallurgic magnifier.

Brinell Hardness Test

The resistance of the composites to indentation was conducted exploitation the BS240 Brinell hardness testing device, a tensometer (MS00-25kN), D-diameter hardened steel ball to indent the take a look at specimen. supported the ASTM specification, a steel ball with a diameter of D = 10 mm was used and also the load applied P was unbroken constant at 3000 kgf. The indentation diameter, d, was resolve in 2 perpendicular ways in which, employing a micrometer of the optical screw gauge. The mean value use equation to attain Brinell Hardness variety (BHN) is

\[ BHN = \frac{2P}{\pi(D-d)^2} \]

Here P = load applied, D = hardened steel ball diameter, d = indentation diameter.

Compressive Strength Test

Then the test for compressive force was performed by the Tensometric Device. The samples with a diameter of 2940 mm were exposed to compressive force and regularly charged before failure occurred. This then registered the load failure at that this occurred.

Ash Content Test

Weighed around 1.20 g ± 0.1 g of the samples in an exceedingly chilled vessel that was dried at 550°C for one hour by heating in a chamber. The samples were then burn by heating upon a hot plate, then that burn samples were placed in a chamber and heated at 550°C for one hour. Then it is cooled and measured in an exceedingly desiccator. This cycle of heating, cooling and reweighing was replicated till a relentless weight was achieved by measurement the ash content exploitation the subsequent equation

\[ Ash content = \frac{W_2-W_1}{W_1-W_0} \times 100 \]

Here W₀ = empty vessel weight, W₁ =vessel and sample weight, W₂ = after cooling crucible residue weight.

Mass Test

Sample density was measured by testing the samples on an automatic weighing system by liquid displacement procedure and estimating their volumes. Density was resolve with the equation below

\[ \text{Density, } \rho = \frac{M}{V} \]

Here M = test piece mass (g), V = test piece volume (cm³) by liquid displacement technique.

Wear Rate Test

The wear rate for the samples was resolve by sliding it at a load of 10N over a forged iron sheet, 125 rev / min sliding speed and 2000m sliding distance using pin on disc machine. The initial sample weight was calculated by an automatic single-pan measuring instrument with an accuracy of 0.01 g. The weight variations determined before and when the tests offer wear to the samples and also the wear rate is calculable exploitation the equation below

\[ \text{Wear Rate} = \frac{\Delta W}{S} \]

Here \(\Delta W\) = sample weight difference, S = total sliding distance (m).
Water Absorption Test
The samples were weighed on an electronic measuring system, and at room temperature were soaked in water for twenty-four hours. The samples were then obtained, washed, and weighed up. Thus, the quantity of water absorption was calculated.

\[
\text{Water Absorption} = \frac{M_2 - M_1}{M_1} \times 100\%
\]

SUMMARY OF RESULT FINDINGS COMPARED WITH EXISTING BRAKE PADS
PAPER: Sadiq Sius LAWAL, Katsina Christopher BALA, and Abdulkareem Tunde ALEGBEDE Development and production of brake pad from sawdust composite., Issue 30, January-July 2017.

| S. NO | PROPERTY | COMMERCIAL BRAKE PAD (Asbestos based) | EXPERIMENTAL BRAKE PAD (Sawdust based) |
|-------|----------|--------------------------------------|---------------------------------------|
| 1     | Hardness (HB) | 102                                  | 259                                   |
| 2     | Compressive Strength (N/mm²) | 111                                  | 114                                   |
| 3     | Ash Content (%) | 54.5                                 | 41                                    |
| 4     | Specific gravity or Relative density | 1.898                               | 1.92                                 |
| 5     | Wear Rate (mg/m) | 3.82                                 | 3.24                                 |
| 6     | Water Absorption (%) | 0.8                                  | 0.64                                 |

PAPER: Z.U. Elakhame, Y.O. Abiodun, N.A. Alausa, O.J. Omowunmi, A.O. Komolafe, Y.J. Obe: Manufacture of Automotive Brake Pads from Sawdust Composites, International Journal of Scientific & Engineering Research Volume 8, Issue 8, August-August 2017.

| S. NO | PROPERTY | COMMERCIAL BRAKE PAD (Asbestos based) | EXPERIMENTAL BRAKE PAD (Sawdust based) |
|-------|----------|--------------------------------------|---------------------------------------|
| 1     | Hardness (at 3000kgf) | 102                                  | 226-259                               |
| 2     | Compressive Strength (N/mm²) | 111                                  | 111-124                               |
| 3     | Density (kg/m³) | 1.321                                 | 1.351-1.752                           |
| 4     | Porosity measurement OIL: WATER | 0.53/0.62                            | 0.50-0.58/0.41-0.75                   |
| 5     | Assessment of Friction Materials and Wear | 3.801 (g/km*10⁻⁴) | 1.887-2.358 (g/km*10⁻⁴) |
| 6     | Flame resistance test at 1 hour | Charmed with 69% ash | Charmed with 30-40 ash |

ADVANTAGES OF EXPERIMENTAL BRAKE PADS (SAWDUST BASED)
• Wood has additional carbon content therefore it tends to extend strength and toughness.
• Carbon has smart thermal physical phenomenon, and affordable tolerance to corrosion.
• Silicon carbide has high hardness, low thermal enlargement and high temperature resistance.