Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 4, 2020

Review Article

REVIEW OF DEVELOPMENT OF BRAKE PADS USING SAWDUST COMPOSITE

G. Anbu[1], N. Manirethinam[2], K.P. Nitish[3], K. Pavithran[4], A. Priyadharsan[5], S. Sabarigiri[6]

[1]Assistant Professor, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.
[2]UG Scholar, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.
[3]UG Scholar, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.
[4]UG Scholar, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.
[5]UG Scholar, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.
[6]UG Scholar, Automotive Engineering Department, Karpagam College of Engineering, Coimbatore.

Received: 12.12.2019 *Revised: 14.01.2020* *Accepted: 23.02.2020*

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 performed. 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.

 DOI: http://dx.doi.org/10.31838/jcr.07.04.46

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 area 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. Obe: 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.

Figure 1: Photos of all the ingredients

Properties of Raw Materials:

SAWDUST:

1. It has a density roughly about 500 – 1500kg/m^3
2. Thermal conductivity varies from 0.369 – 1.01W/mK

3. Crushing strength of 4 – 14N/mm^2
4. Modulus of Elasticity is about 2 – 2.5KN/mm^2

STEEL FIBRE:

1. Tensile strength is between 90 – 130Kg/mm^2
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/cm^3
2. Maximum service temperature is 1380^{o}C
3. Thermal conductivity is about 45W/mK
4. Bending strength is about 250MPa

GRAPHITE:

1. Thermal conductivity varies from 25 – 470W/m^{o}K
2. Specific heat capacity is about 710 – 8130J/m^{o}K
3. Modulus of elasticity is about 8 – 15GPa
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^{o}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/cm^2 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	L.O.I	97.153

TESTS CARRIED OUT IN RESEARCH PAPER

PAPER: Sadiq Sius LAWAL, Katsina Christopher BALA, and Abdul kareem Tunde ALEGBEDE **Development and production of brake pad from sawdust composite.,** Issue 30, January-July 2017.

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 sprucing 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 (M500-25kN), 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 resolute 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

$$BHN = \frac{2P}{\pi D(D-\sqrt{(D^2-d^2)})}$$

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 29.40 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

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

Here W_0 = 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 resolute with the equation below

$$Density, \rho = \frac{M}{V}$$

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 resolute 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

$$Wear\ Rate = \frac{\Delta W}{S}$$

Here ΔW= 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.

$$\text{Water Absorption} = \frac{M_2 - M_1}{M_1} X100\%$$

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-2017.

S. NO	PROPERTY	COMMERCIAL BRAKE PAD (Asbestos based)	EXPERIMENTAL BRAKE PAD (Sawdust based)
1	Hardness (at 3000kgH)	102	226-259
2	Compressive Strength (N/mm^2)	111	111-124
3	Density (kg/m^3)	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 ($g/km*10^{-2}$)	1.887-2.358 ($g/km*10^{-2}$)
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.

CONCLUSION

The following conclusion in accordance with the author [Z.U. Elakhame, Y.O. Abiodun, N.A. Alausa, O.J. Omowunmi, A.O. Komolafe, Y.J. Obe., 2017]

1. The wood dust of 100μm sieve provided all the required properties within the specific samples.
2. With an improvement in sieve grade, the compressive strength, stiffness, densities, and porosity of the samples made were seen to decrease as water soaked, wear rate, and charred percentage decreased as the sieve grade increases
3. Composite brake pads use wood sieve as filler may be used with success as another to current fillers in composites of brake pads, like asbestos, supported the higher than test properties.

The conclusion author [Sadiq Sius LAWAL, Katsina Christopher BALA, and Abdulkareem Tunde ALEGBEDE., 2017]

1. Test findings counsel that 100μm particle size wood sieve has properties which will simply substitute asbestos within the manufacture of brake pads, since its improved brake pad properties.
2. There upon particle size the properties of the samples made, like compressive force hardness density, ash content and water absorption, decreased.

REFERENCE

1. 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-2017
2. Sadiq Sius LAWAL, Katsina Christopher BALA, and Abdulkareem Tunde ALEGBEDE: Development and production of brake pad from sawdust composite., Issue 30, January-July 2017
3. Hee, K.W., P. Filip, 2005. Performance of ceramic enhanced phenolic matrix brake lining materials for automotive brake linings. Wear, 259(7-12): 1088-96.
4. Yawas D. S., Aku S. Y., Amaren S. G., Morphology and properties of periwinkle shell asbestos-free brake pad, Journal of King Saudi University – Engineering Sciences., 2016, 28(1), p. 103-109.
5. Aminu Ohueyi Ahmed, Abdullahi Umar, Bamaiyi Usman Aliyu, Ebenezer Bamidele Omilabu and Sani Yakubu Khalifa., Development of Asbestos Free-Brake Pad Using Solid Waste, ATBU, Journal of Science, Technology & Education (JOSTE); Vol. 6 (2), June, 2018
6. Mathur, R.B. Thiyagarajan, P. and Dhami, T.L. (2004). Controlling the hardness and Tribological Behaviour of Nonasbestos Brake Lining Materials for Automobiles. Journal of Carbon Science, vol. 5, No. 1, 6- 11.
7. Elzey, M., R. Vancheeswaran, S. Myers, R. McLellan, 2000. Multi criteria optimization in the design of composites for friction applications. In: International conference on brakes 2000, automotive brakingtechnologies for the 21st century, Leeds, UK, pp: 197-205.