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Evaluation of Mechanical Properties of Bagasse / Palm Kernel Fibres Fabrication of Automotive Brake Pads

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Abstract: ***Composites which are having a good strength to less weight ratio can be applied to replace the conventionally used engineering materials. Natural fiber constitutes good properties nearly equal to that of artificial fibers. In many applications natural fiber can be applied and also it is an in expensive material. Most of the natural fiber sare extracted from there issue of used agro products. This present study gives a brief characterization report of hybrid natural fiber composed of bagasse and palm kernel shell fiber, which is mixed in the ratio of 50: 50. The mechanical properties of this natural hybrid fiber are studied by varying the micro structure to three different micron levels, such as 100, 200 and 250 µm. From this it is valid that the sample with a size of 100 µm gives a good result by carrying out material characterization test such as tensile test, compressive test density test, hardness and wear test.***

Keywords: Vinyl esterresin, Bagasse fiber, Palm kernel fiber, Material characterization

1. Introduction

Recently many research on natural fibers has been carried out to estimate the mechanical properties for the purpose of engineering application. In the prehistory decennary impede that brake pads were made using asbestos material and it would be banned, due to health hazards and carcinogenic diseases caused by asbestos [1, 2]. At present the brake pads are classified into metallic, semi-metallic, Non-asbestos organic and ceramics. In this work, Non-asbestos organic type brake pad is fabricated [3]. The Non-asbestos organic type brake pads were designed in order to replace asbestos type. Non-asbestos organic employs the use of the matrix of organic and inorganic fillers, reinforcement, abrasive and binders [4]. The strength of the fiber upon the matrix medium in which either epoxy or polyester resin can be used. This paper aims estimate of mechanical properties of varying particle size hybrid natural fiber composed of equal proportions of bagasse and palm kernel shell fiber [3, 4]. These natural fibers are extracted from agro wastes and residues obtained from agro products. It is a cost effective fiber for some specific application. A recent research on micron level investigation of particulate composites is becoming popular in both artificial and natural fiber [5, 6]. Normally artificial fibers such as carbon and glass fiber are widely used in various engineering application since it has good mechanical strength and thermal properties. These had a great disadvantage which can lead to environmental problems in disposal by incineration. In the case of natural fibre it is an environment friendly **composite.**

In this bagasse and palm kernel shell fibre are used for the fabrication of hybrid natural composite. The bagasse is a natural fibre which is obtained from the sugarcane extract while the **palm kernel shell fibre** is extracted from palm [7, 8]. Recent research on bagasse fibre has predicted that it has good wear properties and low water absorption properties. Palm kernel shell fibre also has good wear properties. The reduction of particle size provides good mechanical properties of the fibre to a certain extent [9, 10]. Research was therefore initiated with studying the properties of fabricated hybrid natural composite by varying particle size to micron level.

2. Problem Specification

The compositional design of friction materials is a well-known problem which involves not only the complications of handling the different categories of ingredients, but also reaching in it. Suitable and desired level of performance. This paper presents the fabrication of a new friction material and testing of it in order to achieve better functionality as a friction material by investigating the selection of ingredients and their composition levels.

3. Experimental Procedure

In this work, the hybrid composite brake pad is fabricated by using various composite materials. The materials used for fabrication of hybrid natural composites are Vinyl ester resin, Bagasse fiber and Palm Kernel Shell fiber. Bagasse fiber consists of water, fiber and small quantities of solids in solution in the following proportions. Water 46-57 % (mean 50%), Fiber 43%-53 % (mean 47%), Solids in solution (sugar) 2%-6 % (mean 3%). It consists of mainly cellulose pentosens and lignin. In general, the fresh fruit bunch contains about 27% palm oil; 6- 7% palm kernel, 14-15% fiber, 6-7% shell and 23% empty fruit bunch material. Bagasse fiber and palm kernel shell fiber was chosen to a size of 100, 200, 250 micron. The mixing proportion of bagasse and palm kernel shell was kept constant as 50: 50. Vinyl esteris of unsaturated type which is thermoset matrix capable of being cured to a solid state when a proper proportionate of promoter and catalyst is added.

3.1 Materials properties

Table1. Materials properties Sl. No Materials Specifications

1) Bagasse fibre
   Specific gravity= 1.43 (g/cm 3) Compressive strength=105.6 (N/mm 2) Average wear =4.20 (mg/m)

Density=0.120 (g/cm 3)

2) Palm kernel fibre
Specific gravity =1.65 (g/cm 3) Compressive strength=103.5 (N/mm 2) Average wear=4.40 (mg/m) Density=2.50 (g/cm³)

3) Vinyl ester
Density: 1.05 (g/cm 3) UTS: 60 MPa
Flexural Strength: 130MPa
Heat distortion temperature: 125 o

4) Di-Methyl Acetamide (Promoter)
Density: 0.94 g/cm 3

5) Cobalt Napthalate (Accelerator) Density: 0.98 g/cm 3

6) Methyl Ethyl Ketone Peroxide (MEKP) Catalyst
Density: 1.17 g/cm 3

7) Mylar Sheet Thickness-100 (µm) Density- 1.4 (g/cm 3)

3.2 Fabrication

Hand lay-up is a conventional and easy method for the fabrication of composites. In this paper hybrid fiber natural composite is composed of composed of hybridization of two natural fibers (i. e. bagasse and palm kernel fiber). A simple mold box is used for the fabrication of hybrid natural composite. The two fibers of same micron size are measured and taken at a fixed proportion as mentioned in Table2. With this mold box alaminate of hybrid natural composite is fabricated. The test coupon for material characterization is to be cut as per ASTM standard from the fabricated laminate. Since resin is matrix medium in fabrication of composite, the volume of resin to be mixed should be measured before mixing. Theres in volume is controlled with respect to the mol volume and is given by "Massofresin (m) =Volume of mold x Density of Vinyl ester.

Table 2: Composition of two samples

Sl. No	Samples Micron (µm)	% of Vinyl ester	% wt of Bagasse fibre	% wt of Palm Kernel fibre	Total Weight gm
1	100	50	25	25	500
2	200	50	25	25	500
3	250	50	25	25	500

4. Discussions

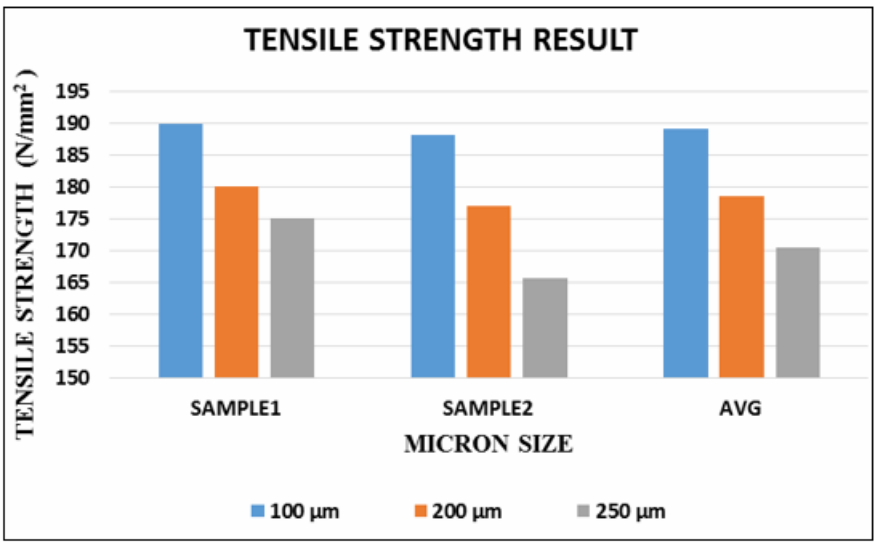
The fabricated hybrid natural fiber is subjected different test to determine various mechanical properties. The hybrid fiber sample was subjected to various tests like tensile test, compression test, hardness test, density test and wear test and they are discussed as one by one.

4.1 Tensile Test

The fabricated hybrid natural fiber with three different particle sizes were subjected to tensile test as per ASTM standard. The test coupon which was prepared using particle size as 100 micron gave a good ultimate tensile strength value is found to be 189.08N/mm 2 as shown in FIG.1 while compared with other two particle size. The fabricated tensile test were carried out as per ASTM D3039. %. The composite pads combination possesses good friction properties, high thermal conductivity, significant wear damage, vulnerable to corrosion due to high mechanical properties of the composites.

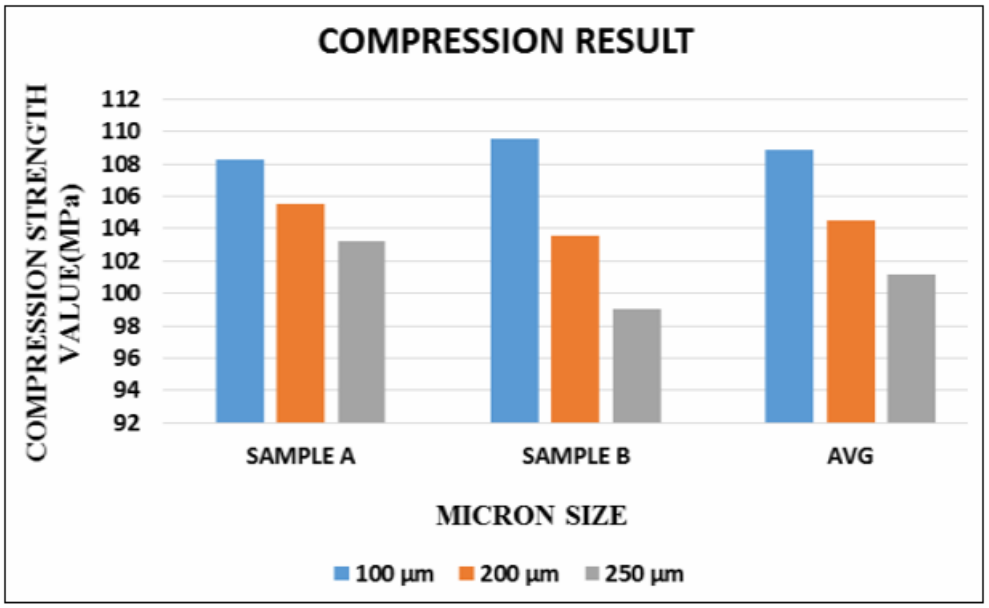
4.2 Compression Test

The fabricated hybrid natural fiber with three different particle sizes were subjected to compression test as per ASTM standard. The test coupon which was prepared using particle size as 100 micron gave a good compression strength value is found to be 108.9MPa shown in fig.2. While comparing with other two particle size. The fabricated compression test coupons were done as per ASTM D638.



4.3 Hardness test

The fabricated hybrid natural fiber with three different particle sizes is subjected to hardness test as per ASTM standard.



The effect of fabricated hybrid natural fiber loading on the hardness of composites. It has been found that the hardness of the fabricated hybrid natural fiber composite increases with the increase in the fibre loading. The test coupon which was prepared using particle size as 100 micron gave a good hardness strength value is found to be 102.98MSwhile compared with other two particle size. The maximum surface hardness value of 106 HRB is obtained frombagasse-25% palm kernel shell fiber, with epoxy and other reinforced composites. Automotive brake pad by using functionally graded hybrid composites and their behaviour. The fabricated tensile test coupons were done as per ASTM E10-12. The hardness test was carried out using a Shore hardness tester.

4.4 Density test

The fabricated hybrid natural fiber with three different particle sizes, is Subjected to Density test as per ASTM standard. The samples were prepared using particle size as 100 microns, density value is found to be1502.41kg/m 3 while compared with other two combinations. The fabricated Density test coupons were done as per ASTM D1621. Initially each test specimen has to be weighed. The weight for apparatus and other required equipment's were measured. The test samples were immersed in water and were weighed. Specific gravity= $a/(a+w-b)$, Where "a" is initial weight and "w" is constant weight and b is final weight. Density (Kg/m 3) = specific gravity x 997.6.

The Density test was carried out using a Westphal Density balance.

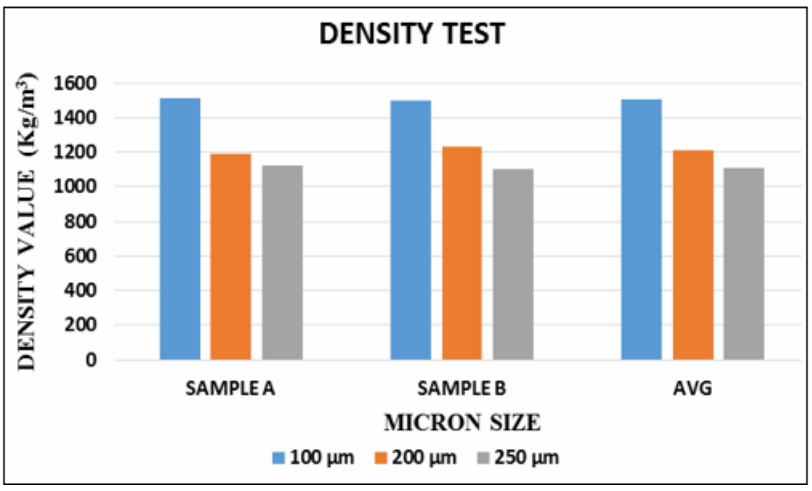


Figure 4: Comparison of Density test

4.5 Wear test

The fabricated hybrid natural fiber with three different particle sizes is subjected to wear test as per ASTM standard. The wear rate of the fabricated composite was made to test in pin on disc machine. The wear rate was performed at load condition by applying a load of 10kN.

The test samples of particle size as mentioned above are subject to wear test. The test samples which was prepared using particle size as 100 micron had a less wear rate value is found to be 3.98 mg/m while compared with other two particle size. The fabricated wear test coupons was done as perASTM G-99. The wear rate of fabricated composite

specimen was calculated by the formula shown below Wear rate $=\Delta W/S$

Where ΔW is the weight difference of the sample before and after the test in mg, S is total sliding distance in m.

4.6 Water Absorption test

In the case of natural fiber the main disadvantage is that it has great moisture absorption characteristic which will lead to failure of composite in early stage. In order to estimate the water absorption capacity of the fabricated composite water absorption test had been carried out for all the specimens as per ASTM D570-98standard. The test specimens were immersed in a bath containing water which is maintained at a temperature of 40ºC for 24 hrs. A similar procedure is repeated for all the three samples of various particle sizes. From the graph it is concluded that the composite which has a particle size of 100 micron shows low water absorption capacity and the value was calculated as 1.05%

5. Result & Conclusion

This paper focuses on the fabrication of vinyl ester, bagasse/palm kernel shell (PKS) particulate composites and studying the effect of various particle sizes by estimating the mechanical properties of the composites fabricated. From this study, it was identified that the mechanical properties of the sample with a particle size of 100 µm provided better result from carrying out various mechanical tests. With these results from the mechanical testing of the hybrid natural composite, it is seen that the current composition of hybrid natural composites exhibits a good mechanical strength. Result of thermogravimetric analysis test indicates, that addition of steel fiber to jute fiber, improves the temperature bearing capacity of the composites up to700-800°C. Based on the wear rate and coefficient of friction properties, this research specifies that non-metallic bagasse/palm kernel shell fibre composites is a viable alternate for other composites The varying weight percentages of composites results in higher coefficient of friction and reduce the wear, which in turn reduces the stopping distance and increases braking performance of the vehicle.

References

[1] Shehu, U., Aponbiede, O., Ause, T., and Obiodunukwe, E. F. (2013), "Effect of particle size on the properties of Polyester/Palm Kernel Shell (PKS) Particulate Composites", *Journal of Materials and Environmental Science,* ISSN: 2028-2508, Vol.5 (2), pp: 366-373.

[2] Isiaka Oluwole Oladele. (2014), "Effect of Bagasse Fibre Reinforcement on the Mechanical Properties of Polyester Composites", *The Journal of the Association of Professional Engineers of Trinidad and Tobago*, Vol.42, pp: 12-15.

[3] Luz, S. M., Gonc¸alves, A. R., Del'ArcoJr, A. P. (2007), "Mechanical behavior and microstructural analysis of sugarcane bagasse fibers reinforced polypropylene composites", Composites: Part A 38, pp: 1455-1461.

[4] Madhukiran, J., Dr. SrinivasaRao, S., and Madhusudan, S. (2013), "Fabrication and Testing of Natural Fiber Reinforced Hybrid Composites Banana/Pineapple", *International Journal of Modern Engineering Research*, ISSN: 2249-6645, Vol.3, Issue 4, pp: 2239-2243.

[5] Aigbodion, V. S., Akadike, U., and Hassan, S. B., Asuke, F., Agunsoye, J. O, "Development of asbestos - free brake pad using bagasse". *Journal of King Saud University - Engineering Sciences*. Tribology in Industry, Vol.32 (1), pp.12-18, 2010.

[6] Rezayati-charani, P., Mohammadi-Rovshandeh, J., 2005. Effect of pulping variables with dimethyl formamide on the characteristics of bagasse-fiber. Bioresour. Technol.96, 1658- 1669.

[7] Maneesh Tewari, Singh, V. K., Gope, P. C., and ArunChaudhary, K. (2012), "Evaluation of Mechanical Properties of Bagasse-Glass Fiber Reinforced Composite", *Journal of Materials and Environmental Science*, ISSN: 2028-2508, Vol.3 (1), pp: 171-184.

[8] Verma, D., Gope, P. C., Maheshwari, M. K., Sharma, R. K. (2012), "Bagasse Fiber Composites-A Review", *Journal of Materials and Environmental Science*, Vol.3 (6), pp: 1079-1092.

[9] S Karthik, PM Sendil, R Elango, M Akilesh, "Wear Behavior of Functionally Graded Automotive Brake Padon Hybrid Composite", International Research Journal of Automotive Technology, 1 (1), 29-34, 2018.

[10] Enrico Pira, Francesca Donato, Luisa Maida, Gianluigi Discalzi, "Exposure to asbestos: past, present and future", Journal of Thoracic Disease, S237-S245, 2018.

[11] Bushra Rashid, Zulkiflle Leman, Mohammad Jawaid, Mohamad R. Ishak Faris, M. Al-Oqla, "Eco-friendly Composites for Brake Pads From Agro Waste: A Review", Materials Science and Materials engineering, 2017.

[12] Motoyuki Miyaji, IWAO Yuji, Friction material composition, friction material and production method there of, US Patent App.15/137, 032, 2016.