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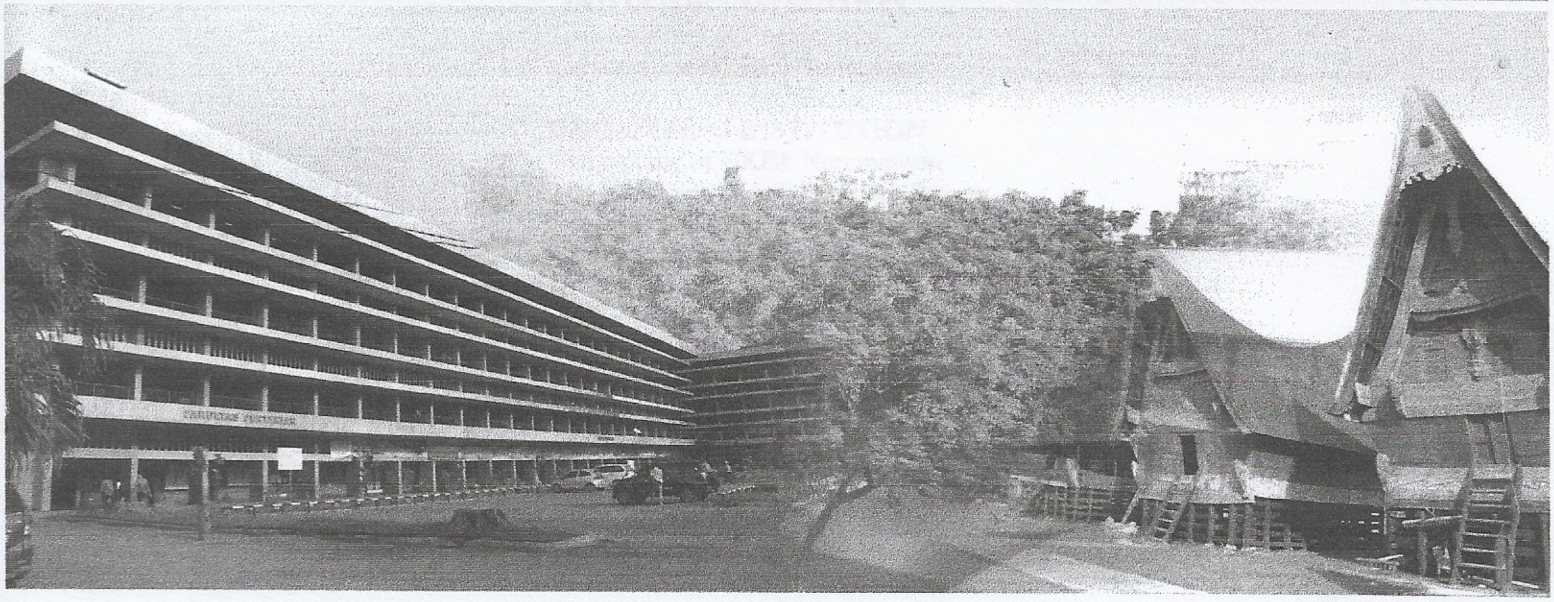

INNOVATION AND APPLICATION OF INTERDISCIPLINARY RESEARCH IN SCIENCE, TECHNOLOGY, AND ENGINEERING

ABSTRACT

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Effect of cocopeat and brass powder composition as a filler on wear resistance properties

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Effect of cocopeat and brass powder composition as a filler on wear resistance properties

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Abstract. This hybrid composite is a combination of materials from cocopeat and brass powder as reinforcement with polyester resin as a binder. This hybrid composite is applied to disc pad product material. In the percentage of the composition will be affected of wear resistance of the product. The functions of disc pad as a brake where the principle works rubbing against the disc brake, it is necessary to have composite wear testing. This research method uses the ogoshi method on wear testing by varying the composition of the percentage of cocopeat and brass powder and in testing there are 2 treatments, namely dry and wet conditions. The results showed that sample 6 with a composition of 40% cocopeat and 60% brass powder had wear resistance of 3.3 x 10-6 mm^2 / kg with a temperature of 41 ^oC in dry conditions and 2.02 x 10-6 mm^2 / kg with a temperature of 40 ^oC wet. Wear resistance in sample 6 is higher than disc pad market and close to below the original market so that this composition can be recommended as a disc pad material.

1. Introduction

This hybrid composite is a combination of reinforcement consisting of cocopeat with brass powder and polyester resin matrix. In two different ratios, the compression molding process of this study is to improve mechanical performance without reducing the use of high percentages of natural components used in environment-friendly natural fiber-based composite preparations [1-2]. Morphology of hybrid composites is more homogeneous with the presence of coupling agents (CA) which show enhanced fiber-matrix adhesion [3-5]. In addition, it increases the mechanical strengthening effect on tensile properties, including elongation at break. Addition of coconut fiber resulted in a 27% increase in elastic modulus and 47% in tensile strength when compared to fiber-free cork-based composites (50-50) wt. This research clearly shows that the addition of 10% short coconut fiber, randomly distributed, can be effectively used as a strategy for strengthening cork-based composite materials, preferably in the presence of 2% CA weight and particle size [6], [7].

Commercially, the use of hybrid composites is less used in engineering applications en masse, such as brake pads. Production of brake pads that have been commercialized so far using asbestos mixture. In the use of materials for engineering needs today are preferred based on environmentally friendly. Therefore, this research was carried out by utilizing natural materials classified as waste such as cocopeat obtained from coconut fiber waste which was taken by fiber combined with brass powder obtained from the production process

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waste which was able to be used as brake pad material. It is necessary to do research to find the composition of the material for brake lining based on the results of the test of wear properties.

This creations aims is to learn about the differences in tribological properties of non-commercial brake pads designed with and without asbestos under various nominal contact speeds and pressures. Two non-commercial asbestos brake pads (ABP) and non-asbestos brake pads (NABP) materials have been tested and compared with commercial brake pads (CMBP) materials selected using tribo-test-rig dry pin-on-disc conditions. The results showed that the friction coefficient for all materials is not sensitive to increasing speed and pressure. NABP maintains a stable friction performance as ABP material when the contact temperature increases. In addition, NABP is proven to have greater wear resistance compared to ABP and CMBP materials. In addition, SEM micrographs from the surface of the brake pads show craters caused by highland disintegration. Finally, the test results show that NABP has potential braking characteristics for bearing materials [8,9].

This study deals with brass debris obtained from matte smelting and purification of brass from various machine processes used as fillers in epoxy-resin composites. [10] The use of brass is the recycling and production of value-added waste products. In this study, a random mixing process was used to prepare composites (Epoxy / brass) using brass flakes. This study also examined the mechanical procedures and behavior of brass debris filled with epoxy-resin composites. The results concluded that it would be possible to utilize brass chips as a secondary fill element for the preparation of composite materials and production of brass chips as value-added products that could be used as fillers for brake pads, [11] and alluminium and fly ash could be used as fillers [12,13] The development of brake lining production from sawdust composites has been carried out [14, 15] from the results of the above research so that research on brake linings using cocopeat and brass powder is used as filler with polyester resin matrix as a binder.

2. Method

The materials used in this composite are, coconut fiber cork (cocopeat) and brass powder as reinforcement and polyester epoxy resin as a matrix. In making test specimens varied the composition between cocopeat and brass powder, while the composition of polyester resin remains. The composition of cocopeat and brass powder used are 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80% and 90%. In the process of making specimens using steel molds then the composite mixture is pressed and pressed using hydraulic with a pressure of 5 bar and heated with a temperature of 40 ^{o}C.

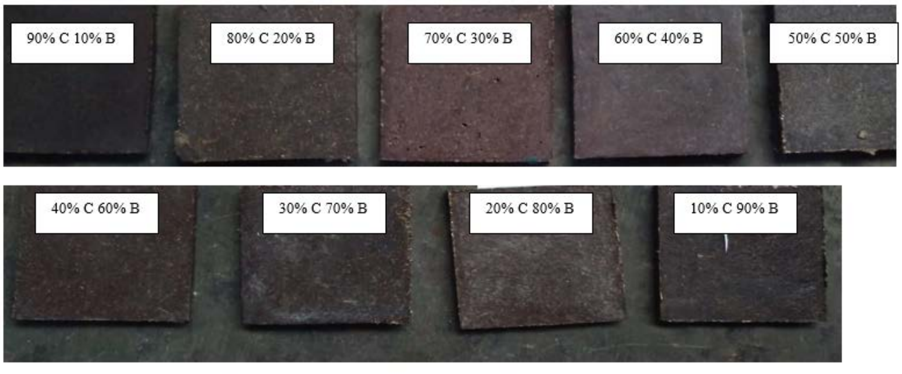

Figure 1. Specimen wear test composite cocopeat (C) and brass powder (B)

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This brake lining test used wear testing with used the ogoshi method that uses wear testing. The purpose of this test is to know the composite hybrid which applied as brake lining. The standard used in this wear testing uses the ASTM G99 standard. In this wear test, which acts as a medium of wear / friction against composites using a revolving disc. This revolving disc is given a load so that it produces traces of wear on the composite.

Figure 2. Wear testing ogoshi method

The wear testing procedure using the ogoshi method is as follows:

1. Turn on the power source by pressing the switch button ON
2. Install the revolving disc in place
3. Install the composite / test specimen
4. Install the gear according to the load, speed and sliding distance.
5. Set the initial load on the zero position machine (see the scale of the peephole) until the needle shows a 4.5 mm scale number.
6. Press the ON switch button for the test process to run
7. Calculate the gap in abrasion with a microscope.

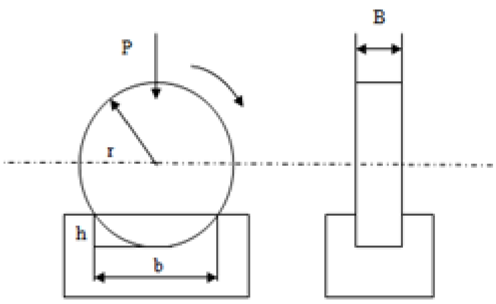

Figure 3. Schema wear testing

Information :

P : load (kg)
r : revolving disc radius (mm)
B : Thick revolving disc (mm)
b : abrasion trace width (mm)
h : abrasion trace depth (mm)

Wear rate can be expressed by the amount of loss of material / material that is abrased (mass, volume or thickness) of each unit of sliding distance or unit of time. Therefore determining the wear rate can be stated :

$$W = \frac{V_i - V_f}{t} \qquad \text{(1)}$$

With V_i = initial volume of specimen (mm^3), V_f = final volume of specimen (mm^3), t = length of scouring time (s). because V_i - V_f is equal to the abrasive volume (V), the wear rate can be stated:

$$W = \frac{V}{t} \qquad \text{(2)}$$

The missing scour volume in the test specimen is expressed by equation 3.

$$V = B\left[r^2 \sin^{-1}\left(\frac{b}{2r}\right) - \frac{b}{2}\sqrt{r^2 - \frac{b^2}{4}}\right] \qquad \text{(3)}$$

Where B = revolving thick disc (mm), r = disc radius (mm), b = wear width (mm) obtained from observation through a microscope.
Wear can also be stated with specific wear. Specific wear is calculated from the width of the material consumed by the wear disk, sliding distance and compression load. Specific wear has the symbol Ws in units of mm2 / kg, which means one unit area of material eroded per unit weight. Formula in determining specific wear can be stated :

$$W = \frac{B.b^3}{8.r.P_o l_o} \qquad \text{(4)}$$

With B = revolving disc thickness (mm), b = abrasion width (mm), Po = compressive load at wear (kg), lo = sliding distance in the wear process (mm).

3. Results and Discussions

Abrasion Specific Rate

In determining the specific wear rate on composite hybrid cocopeat with brass powder as fillers using formula 4, where the revolving thickness of the disc was determined to be 3 mm, the radius of the disc was 14 mm, the pressure load was 2.12 kg and the sliding distance was 66.6 m (66600 mm). In this study varied the percentage composition between cocopeat and brass powder. As in figure 4, samples 1 to 9 are percentage compositions. The composition per percentage is sequentially between cocopeat and brass powder, ie: 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90 %.

Tabel 1. result of testing the wear of the ogoshi method

Sample	Abrasion Specific Rate Dry Condition (mm^2/kg)	Abrasion Specific Rate Wet Condition (mm^2/kg)	Temperature Composite Dry Condition (ºC)	Temperature Composite Wet Condition (ºC)
Sample 1	1,7 x 10^{-5}	1,31 x 10^{-5}	30	29
Sample 2	1,4 x 10^{-5}	8,85 x 10^{-6}	32	31
Sample 3	1,04 x 10^{-5}	6,82 x 10^{-6}	34	33
Sample 4	7,46 x 10^{-6}	4,16 x 10^{-6}	36	35
Sample 5	4,63 x 10^{-6}	2,96 x 10^{-6}	39	38
Sample 6	3,33 x 10^{-6}	2,02 x 10^{-6}	41	40
Sample 7	1,76 x 10^{-6}	1,11 x 10^{-6}	45	43
Sample 8	9,32 x 10^{-7}	6,4 x 10^{-7}	47	45
Sample 9	6,4 x 10^{-7}	4,17 x 10^{-7}	50	47
DPM	6,85 x 10^{-6}	3,5 x 10^{-6}	40	39
Orisin M	6,5 x 10^{-7}	5,9 x 10^{-7}	43	42

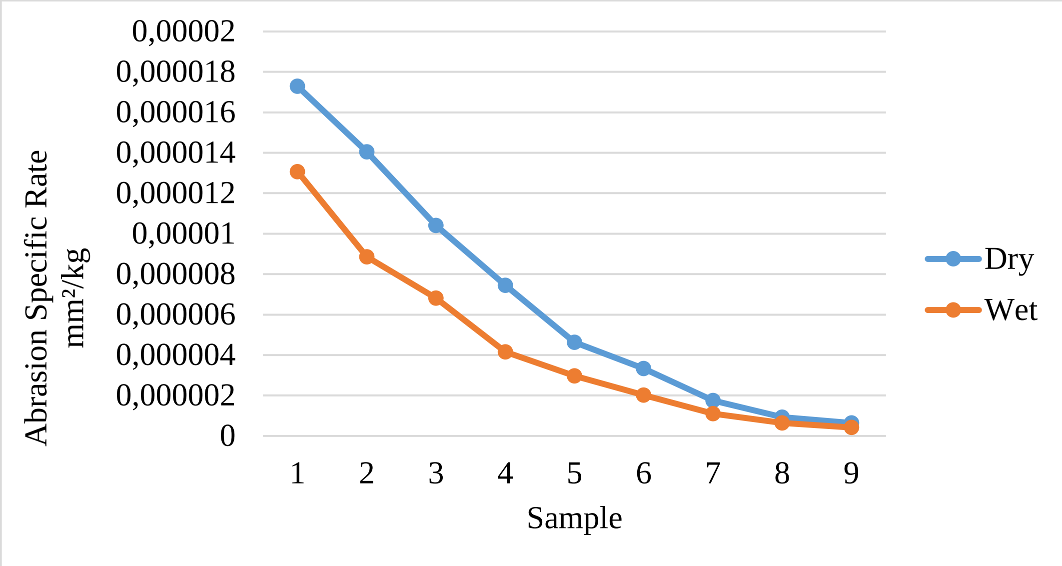

Figure 4. Effect of percentage composition cocopeat with brass powder

In the wear test with the ogoshi method there are 2 treatments in the test, namely the composite in dry and wet conditions. The purpose of taking the test with this treatment is to approach the actual state of application as a disc pad material.

Fig.4 shows the downward trend in abrasion specific rates. The higher the brass powder composition the lower the abrasion specific rate. In abrasion specific rates, the lower the value, the higher wear resistance of the material. In the wear test using the ogoshi method, the material is slightly eroded and the specific rate abrasion is small, because the wear of the material is affected by the volume that is abrased. At Fig. 4 lowest specific rate abrasion in the composition of 10% cocopeat and 90% brass powder, this is because the composition is dominated by non ferrous metals where the physical properties, especially the wear resistance of non-ferrous metals are higher than natural fibers. However, with high wear resistance can cause other effects, namely material temperature due to friction as Fig. 5.

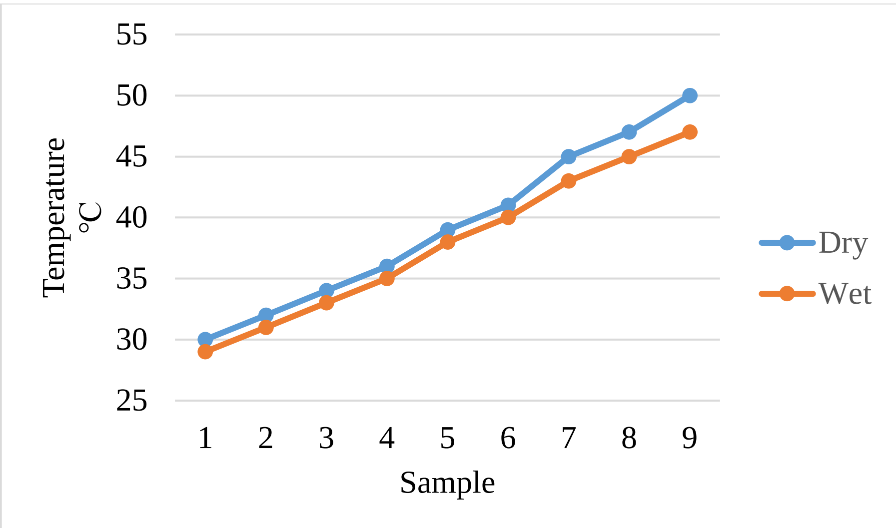

Figure 5. Temperature composite on wear test ogoshi method

At the temperature of the material at the time of testing has increased temperature. This graph is inversely proportional with the abrasion specific rate graph. In samples 6 to 9 are dominated by brass powder, which has high wear resistance so that the temperature of the material when testing is high. This is due to friction between metal disc wearers with non ferrous brass metals.

Comparasion With Product Markets

The purpose of this study is expected to be a recommended material for disc pad products, it is necessary to compare the results of research with market products. In the products that have been marketed there are 2 types, namely, the original market and the disc pad market. Each type of product has advantages and disadvantages.

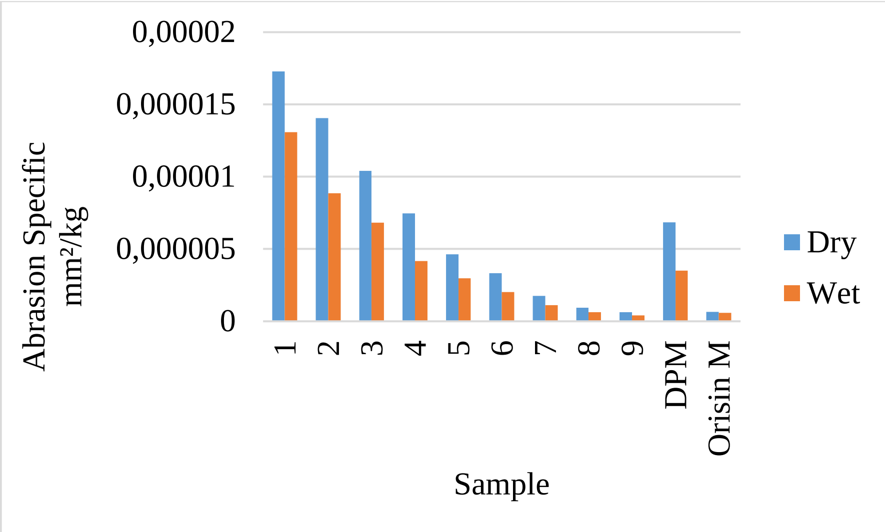

Figure 6. Comparasion abrasion specific rate result research with product markets

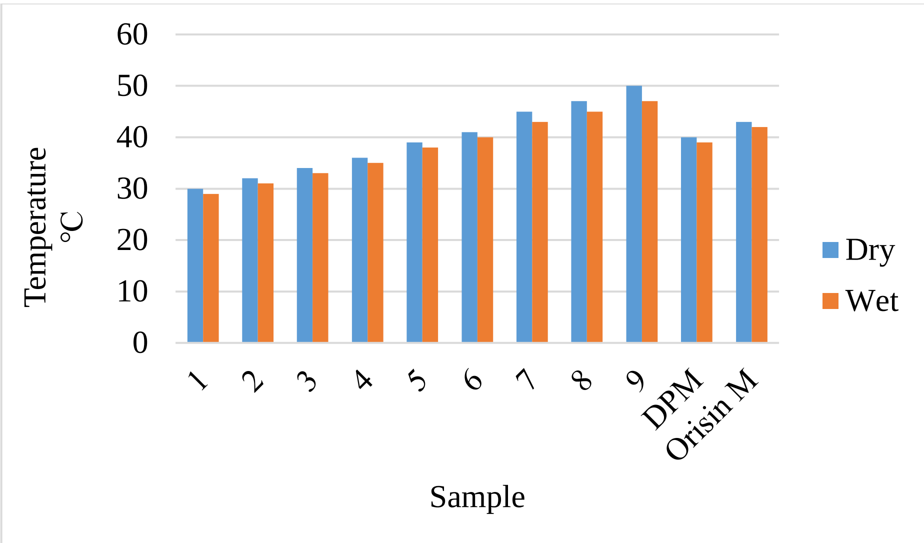

Figure 7. Comparasion temperature result research with product markets

In comparing the results of research with market products by reviewing the wear resistance with temperature material during testing, because the two data are interconnected and have an influence on the disc pad clamping performance on disc brakes. Fig. 6 shows samples 5 to 9 have higher wear resistance than the disc pad market (DPM) but samples 5 to 8 wear resistance is lower than the original market and sample 9 is higher than the original market. Whereas if it is connected with Fig. 7 samples 6 to 9 have a higher temperature than the disc pad market and original market. The disc pad market has wear resistance 6,85 x 10^{-6} mm^2/kg with a temperature of 40 oC in dry conditions and 3,5 x 10^{-6} mm^2/kg with a temperature of 39 oC under wet conditions. Where as the original market has wear resistance 6,5 x 10^{-7} mm^2/kg with a temperature of 43 oC in dry conditions and 5,9 x 10^{-7} mm^2/kg with a temperature of 42 oC under wet conditions. By reviewing Fig. 6 and Fig. 7 which can be recommended for disc pad material in sample 6 because it has a higher wear resistance than the disc pad market and is lower than the original market while the testing temperature is higher than the disc pad market but still below the original market temperature. The sample 6 has wear resistance 3,3 x 10^{-6} mm^2/kg with a temperature of 41 oC in dry conditions and 2,02 x 10^{-6} mm^2/kg with a temperature of 40 oC under wet conditions.

4. Conclusion

The percentage composition of cocopeat with brass powder using polyester resin matrix affects wear resistance and composite temperature during testing. The higher the composition of brass powder the higher the wear resistance and composite temperature during testing. Hybrid composites that can be recommended as disc pad material are sample 6 with a composition of 40% cocopeat and 60% brass powder because it has a higher wear resistance than the disc pad market and is close to below the original market wear resistance.

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