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Coffee Skin Fiber Biocomposite for Brake Pad Applications

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***Abstract*— In this research, a biocomposite made from brass, magnesium oxide and polyester is filled with coffee skin powder fibers using a compaction method using a hydraulic press machine as a specimen maker. Biocomposites have variations in coffee skin powder of 10%, 20%, 30%, 40%, 50% by weight and were investigated for the hardness and surface morphology of brake lining. The hardness strength increased with the addition of coffee skin powder and was found to be higher than the matrix. Microscopic observation shows that the biocomposite bonds are not homogeneous. This is indicated by the presence of voids in the biocomposite specimen.**

Keywords—coffe skin, hardness test, surface morphology, brake pad

I. Introduction

The increasingly advanced development of technology and industry requires new innovations to replace limited materials, for example motor vehicle components. The development of transportation, especially in the automotive sector, has made motorbike assembly manufacturers develop engine and vehicle body performance. One of the characteristics of good vehicle performance is a braking system that is very effective and safe. One component of the braking system is the brake lining. The function of brake pads is to slow down the speed of the vehicle [6].

In general, brake lining material is a composite consisting of three materials, namely binder, reinforcement and filler. The binding materials are various types of resin: phenolic, epoxy, polyester, silicone and rubber which can create a matrix. The reinforcing material is in the form of fiber, which in general is the fiber used to make friction material for brake linings. Polyester resin was chosen because 70% of all industries use this type of resin, because it has very strong bonding properties to other materials and is one of the thermosetting polymers which is very resistant to high temperatures, so it is suitable as reinforcement for a composite used as brake lining because requires a material that is very resistant to the heat generated due to friction between the brake lining and disc. However, on the other hand, apart from having the advantages of unsaturated polyester resin, it also has disadvantages in the application of resin composites, namely that the mechanical properties are lower than other types of resin, so reinforcements and fillers are added to improve certain mechanical properties [3].

Some fillers used as polymer composite brake lining reinforcement can be divided into asbestos and non-asbestos fibers. However, the use of asbestos fiber has a negative impact on health because asbestos powder is difficult to decompose, causing respiratory symptoms. Research in 2 health fields states that asbestos fiber can cause lung cancer and cause respiratory tract problems in humans. In 1986, the Environmental Protection Agency (EPA) in America proposed a ban on the use of asbestos fiber in motor vehicle brake linings [2].

Several studies have used natural areca nut shell fibers and alumina powder metal fillers, such as that carried out by [1] in the process of making fiber polymer biocomposites for brake lining applications. The advantages of using areca nut shells and alumina affect the mechanical properties in the form of hardness of non-asbestos brake lining composites. The disadvantages of this feature are the availability of areca nut skin which is difficult and the hardness is still not close to asbestos brake lining on the market and the heat transfer is very large due to the use of alumina which is the best heat conductor but has very soft hardness. Calcined alumina has a rougher and brittle structure and measures around 5 – 10 mm [4].

Therefore, in this research, coffee skin fiber was used as a composite fiber by mixing magnesium oxide as a filler and polyester resin as a matrix and applied as a replacement material for asbestos brake lining. There is a lot of coffee cup waste, especially in Jember district, due to the increasing production of coffee beans every year. Hardness and microstructure testing was carried out to determine the suitability of coffee skin fiber as a friction material to replace asbestos as a brake lining material in the automotive industry.

II. Material and Method

A. Material

Coffee skin fiber is obtained in the Sidomulyo area, Silo District, Jember 21 Regency, which is one of the coffee producing areas in Jember Regency. Brass powder, Magnesium Oxide, Polyester Resin, and Catalyst obtained from ecommerce

B. Preparation of Coffee Skin Powder, Magnesium Oxide and Brass

Clean the coffee skin with water then dry it by hanging it in the sun until dry. Next, the powder making process uses a grinding machine, enter the coffee skin, magnesium oxide and brass separately into the grinding machine then it becomes powder.

C. Fabrication of Coffee/Magnesium Oxide/Brass/Polyester Leather Biocomposite

Coffee husk powder, magnesium oxide, brass and polyester are mixed using a glass beaker then stir evenly, a catalyst is added to speed up the hardening, then during the compaction process, pour the mixture into the existing mold in the hydraulic press machine, spread the mixture evenly into the mold, the mixture is in The mold is compacted or pressurized using a compaction machine using a load of 2 tons (2000 kg) and sintering at a temperature of 150 for 15 minutes. Biocomposites have been produced in accordance with ASTM.

D. Hardness Test

The biocomposite hardness test was carried out using shore. Hardness test are carried at room temperature according to ASTM D 2240 [9].

E. Surface Morphology

Surface images were captured using a scanning microscope model olimps which was carried out in the laboratory of the Mechanical Engineering department, Faculty of Engineering, Jember University. Microscope observations were carried out at a magnification scale of 200 times on the surface of the brake lining [10].

TABLE 1 BIOCOMPOSITE COMPOUNDS DETAIL

No	Name	Coffe Skin Powder	Cu-Zn	MgO	Polyester
1	SKK50-K10	50%	10%	20%	20%
2	SKK40-K20	40%	20%	20%	20%
3	SKK30-K30	30%	30%	20%	20%
4	SKK20-K40	20%	40%	20%	20%
5	SKK10-K50	10%	50%	20%	20%

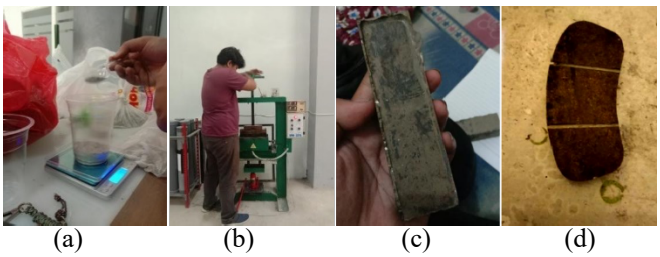

Fig 1. making samples (a) weighing materials (b) compaction process (c) brake lining (d) formed brake lining

III. Result and Discussion

A. Harsness Test

The hardness of a material is a very important mechanical property, because it can be used to determine other mechanical properties, namely strength. The tensile strength value of a material can also be converted from its hardness. In general, the hardness of a material differs depending on the material from which it is made [7].

The addition of coffee skin powder has an effect on the hardness value of the brake lining biocomposite as shown in Table 1. As can be seen, the hardness strength of the biocomposite increases with the addition of coffee skin powder content. Previous research [5] states that, in terms of the mechanical properties of biocomposites increasing, this is because the bond between the fillers is good, which causes greater hardness strength. This is shown in the hardness strength graph showing that the addition of coffee skin powder increases the hardness strength by up to 2,1 shore compared to brake linings on the market. In this research, the coffee skin powder/brass/magnesium oxide/polyester biocomposite had better hardness when the coffee skin powder was added with a weight of 50%, namely it had a hardness value of 83 shore.

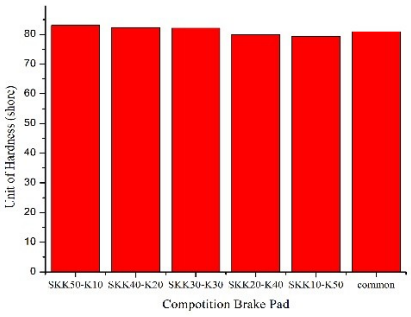

Fig 2. Result Hardness Test

B. Surface Morfologi

The surface morphology of the brake lining was observed to reveal the failure mechanism and examine the dispersion of the filler matrix in the coffee/brass/magnesium oxide/polyester leather powder biocomposite [8]. A microscope image of the brake lining surface is shown in the figure. The surface of the brake pad (fig. 3), as can be seen, the mixture of composites is not yet homogeneous. This is indicated by the clumping of the coffee skin in several places and the formation of voids due to the clumping of Magnesium Oxide which is not evenly wetted by the resin. This can be caused by the stirring process not taking long enough or

manually using your hands, it is better to use a magnetic stirrer [11]

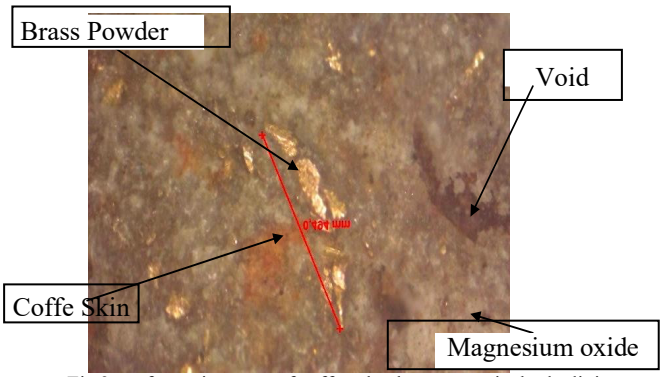

Fig 3. surface microscop of coffeee leather composite brake linings

IV. Conclusions

Biocomposite Coffee leather powder/brass/Cu-Zn/MgO/polyester was successfully prepared using the compaction method, the hardness and morphology properties were studied. The hardness strength increases with the addition of coffee husk powder at a load of 50% of the total weight of the biocomposite, which is 83 shore. Microscope observations show that it has not been evenly dispersed. This is indicated by the clumping of the coffee skin in several places and the formation of voids due to the clumping of Magnesium Oxide which is not evenly wetted by the resin.

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