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Mechanical Characterization Of Composites Reinforced By Corn Husk Fiber (Zea mays) Waste and Coffee Husk Fiber (Coffea Arabica L)

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Abstract. The utilization of corn husk and coffee husk waste has not been maximized. This research was carried out by making composites using fibers from corn and coffee husks. This study aimed to determine the characteristics of the tensile strength and bending strength of the composite of corn husk fiber and coffee husk fiber at optimal fiber volume variations. This study was conducted with variations in the volume ratio of corn husk fiber and coffee husk used, namely: (10% : 90%), (20% : 80%), (30% : 70%), (40% : 60%) and (50% : 50%). The previously modified fibers with 5% NaOH treatment for corn husk fibers and 3% NaOH for coffee husk fibers. The method used in specimen printing is the Hand Lay Up method. The results for the tensile test at 0% fiber variation of 5.174 MPa, 10% : 90% variation of 7.539 MPa, 20% : 80% variation of 7.144 MPa, 30% : 70% variation of 7.901 MPa, 40% : 60% variation of 7,970 MPa and a variation of 50%: 50% of 8,321 MPa. The results for the maximum bending test were obtained at a variation of 50%: 50% of 7,720 MPa.
Keywords: Composite; mechanics characterization; corn husk fiber; coffee husk fiber.

1. Introduction

Mature this utilization and use of composite the increase fast along with developing technology in field industry. A Composite is a mixture or combination of two materials or more shapes, a new material that has more benefits from the Theory of its constituents. Composite shared two types: synthetic and natural (fiber experience) [1]. So far, the use of leather waste corn is not yet optimal. Waste corn husk is widely used as feed cattle, to wrap food traditionally, as basic materials for handicrafts, and others. Composition corn husk is cellulose 57.74%, Hemicellulose 34.03%, and Lignin, 4.46%, and Pectin at 3.77% [2].

In a study conducted, making composite from fiber Labourer corn with matrix polyurethane. From the results test Tensile, the known score strength Tensile composite fiber corn husk increased compared to straight with variation volume fiber [3]. On study tested the composite tensile strength of the bamboo fiber and corn husk with polypropylene matrix, which was previously conducted with variation fiber 10%, 20%, 30%, 40%, and 50% obtained results by consecutive: 8.65 MPa, 5.68 MPa, 9.09 MPa, 7.17 MPa, 20.01 MPa, 9.09 Mpa [4].

Coffee is a type of plant that results in a plantation population in Indonesia, which is big enough and even has been exported to several countries. Processing fruit coffee produces waste like the husk and flesh of the fruit. Coffe husk wastes not yet utilized by maximum and thrown away haphazardly, which could pollute the environment. The chemical composition of husk coffee is cellulose, hemicellulose, and Lignin, which have natural thermal and resemble fiber wood. Husk coffee has a composition of celluloseas much 57% and lignin 22% [5]. Corn husk fiber and coffee husk are show in Figures 1a and 1b.

Figure 1a. Corn Husk

Figure 1b. Coffee Husk

The element in The chemical composition of Fiber is a carbohydrate, such as cellulose and hemicellulose and non- carbohydrate is Lignin [6] Cellulose on generally obtained from plants, and some come from biosynthesis by microorganisms. Cellulose $(C_6H_{10}O_5)_n$ is a polymer long-chain carbohydrate polysaccharide in a network fibrous on the cell wall [7]. Alkali treatment with NaOH on Fiber is a process remodel on the fiber surface by soaking the Fiber in an alkaline solution. This treatment could dissolve layer candles like Lignin, and dirt other, which are contained in surface fiber. NaOH is used as a reagent to increase the reactivity of cellulose and cut off bond hydrogen in cellulose [8].

Resin polyester is the wrong matrix, a character thermoset that is a material that cannot become soft even with reheating at a temperature above the former. Polyester is resin in the form of fluid clear with a relatively low viscosity, which could harden in a temperature room with an extra catalyst that does not produce gas. Pressure and temperature contribute significantly to the retention and violent polymer [9]. In the making material composite, the matrix is used as an ingredient fastener, amplifier, and protector of the particle from damage caused by factor environment [10].

A catalyst is a chemical substance that speeds up the reaction process of structural polymerization of composites at room temperature and atmospheric pressure. Catalyst working shortens and speeds up reaction curing (hardening resin fluid). The catalyst used in the study is catalyst Methyl Ethyl Ketones Peroxide (MEKPO) forms liquid, colored clear [11].

Tensile Test is a test that is used to know the strength of something ingredient or material that provide an axial force load. Test Tensile is testing which fundamental. The bending strength or strength curve is testing for knowing the score endurance material composites against flexural loading, which aim to know the elasticity ingredient. Strength bending depends on the material and extensive loading [12].

2. Experimental

2.1. *Ingredient, equipment, and instrumentation*

The tool used in This research is a glass beaker, stirrer, digital scales, filter 100 mesh, and 200 mesh, a mold of iron size 15 x 12 x 0.5 cm, plate iron, period push, cutters, blender, and grind. The ingredient used is NaOH 5%, NaOH 3%, Aquadest, corn husk, husk coffee, resin polyester, and catalyst MEKPO. The instrumentation used for test Tensile and test bending is Tensilon Universal Testing Machines.

2.2 *Sample preparation*

a. Synthesis corn husk fiber and coffee husk fiber

Corn husk takes part husk outermost until the husk layer fourth. Then corn husk is cleaned and soaked with water for seven days. After that, fiber corn was dried under ray sun to dry. Fiber corn that was already dry was given treatment by immersion using 5% NaOH for 2 hours, then drained and rinsed with aqua dest until fiber corn husk the clean of solution NaOH. Corn husk has already been rinsed and dried, then Fiber mashed using a blender.

The coffe husk is cleaned and soaked using NaOH 3% At 3 o'clock. Then the coffe husk is washed clean with aqua dest in 3 cycles until pH neutral is achieved. After that, the coffee husk fiber is baked in the oven for 24 hours at 80°C. Coffe husk that has been dried, mashed using a blender, and sifted with size 200 mesh.

b. Composite manufacturing

Print and plate Closing coated with aluminum foil. Then pour resin polyester into the receptacle mixing and add fiber corn and coffee according to the percentage that will be printed. Then the mixture was stirred with a motorcycle stirrer. After 2 minutes, add catalyst MEKPO as much as 5% into the mixture, then stir and return using a motorcycle stirrer. Afterward, the ingredient mixture was poured into the mold , flattened, and then covered with a plate iron. Then print was entered into a hot press at 80°C for 3 o'clock. Then let it cool down, after that sample is ready to tensile test and test bending.

c. Tensile Strength Test

Test Tensile (Tensile Strength) is a test on a material with gripping and then drawn material until disconnected. The destination from testing strength Tensile; is for knowing the level of strength Tensile and modulus from the material tested. The sample size is 12 x 2 x 0.5 with distance middle 5 cm. Figure 2a. Shows a sample tensile test.

d. Bending Test

Test strength bending was conducted with method 3 point bending, placing the sample at 3 points. Specimen placed in the position of two supports with distance which has determined then given load at the center of the pedestal with constant loading. Size sample for bending test is 12 x 2 x 0.5 cm. Figure 2b. Shows a sample bending test

Figure 2a. Composite Sample Tensile Test and **Figure 2b**.Sample Bending Test

e. Data Analysis

Analysis data in the study is with the volume fraction variation in the husk fiber corn and fiber husk coffee arabica. Variations is 10% : 90%, 20%:80%, 30%: 70%, 40%:60%, 50%:50% where every variation of Fiber, there is a 50:50 Between fiber corn husk and fiber husk coffee arabica, On every sample conducted, testing swells three times, then data obtained from average results test every sample. Data obtained is depicted in Grafik and the table.

3. Results and Discussion

3.1 Results Tensile Test

Test strength Tensile was conducted to know the influence of different fiber volume fractions on tensile strength, strain, and modulus of elasticity of composites. After conducting testing, Tensile use the tool *Tensilon Universal Testing Machine* with three repetitions of the test time so obtained average data test Tensile:**Table 1**. Results average Tensile Test

Table 1. Results Tensile Strength AverageTest

Sample	Tensile Strength (MPa)	Modulus Elasticity (MPa)
0% (0% Fiber : 100% polyester)	5,174	28,752
10% (10% Fiber : 90% polyester)	7.539	28,212
20% (20% Fiber : 80% polyester)	7,144	26,548
30% (30% Fiber : 70% polyester)	7,901	25,885
40% (40% Fiber : 60% polyester)	7,970	24,743
50% (50% Fiber : 50% polyester)	8,321	22,262

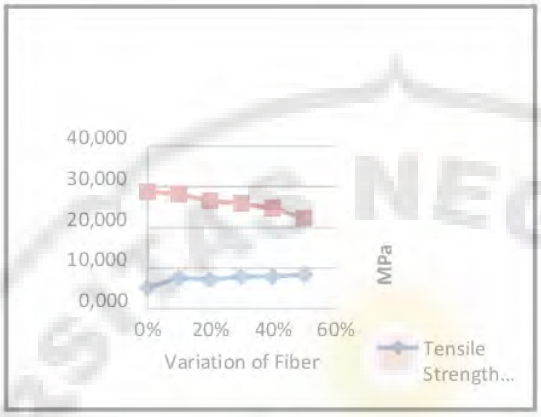

Figure 3. Composite Tensile Strength and Modulus Elasticity

In every variation sample, the Fiber used with fiber ratio corn husk and Fiber husk coffee arabica is 50: 50. Based on the table data test Tensile on so obtained average strength Tensile variation fiber 0% as big as 5.174 MPa, 10% fiber variation of 7.539 MPa, 20% fiber variation of 7.144 MPa, variation fiber 30% as big as 7,901, variation fiber 40% as big as 7,970 and variation 50% as big as 8,321 MPa.

On variation fiber 0%, there is strength Tensile most low. Variation 0% is a sample with 0% fiber and 100% polyester. While the 20% fiber variation experienced a decrease in tensile strength, i.e., as big as 7,144 MPa. Strength Tensile is high in the 50% fiber variation, samples consisting of 50% fiber and 50% resin 8,321. Polyester MPa.

The average modulus elasticity of polyester composite is the tallest obtained at 0% volume fraction variation, which is 28,752 Mpa. For the modulus of elasticity, most low is obtained at the volume fraction variation of 50%, that is 22,262 MPa. Based on the data, the modulus elasticity experiences a drop with the increased volume of Fiber used. The greater the volume of Fiber, the value of the modulus of elasticity will be smaller. The decrease in the value of the modulus elasticity shows that the more fiber increases, the more elastic the composite becomes. In Picture 3 can see the chart strength Tensile and modulus of elasticity of polyester composites with variations in the volume of corn husk fiber and fiber husk coffee

The graph shows that the tensile strength increases from variation 10% - 50% corn husk fiber and coffee husk and composite tensile strength values with variations of Fiber taller compared with composite with matrix pure (variation 0%); however, on variation 20% experience no drastic decrease in tensile strength, p caused by several factors for example, weak bond Among Fiber on composite, mixing Fiber no equally and stirring which is not homogeneou [13]

3.2 Results Test Strength Bending

Test strength bending is for knowing the big price style's maximum moment bend. Test flexural strength using the *Tensilon tool Universal Testing Machines*. Following is the average result of 3 repetitions of test strength flexible variation fiber composite polyester.

Table 2. Results Average Bending Test

Sample	Bending Strength (MPa)
0% (0% Fiber : 100% polyester)	2,329
10% (10% Fiber : 90% polyester)	4,698
20% (20% Fiber : 80% polyester)	3,739
30% (30% Fiber : 70% polyester)	6,151
40% (40% Fiber : 60% polyester)	6,809
50% (50% Fiber : 50% polyester)	7,720

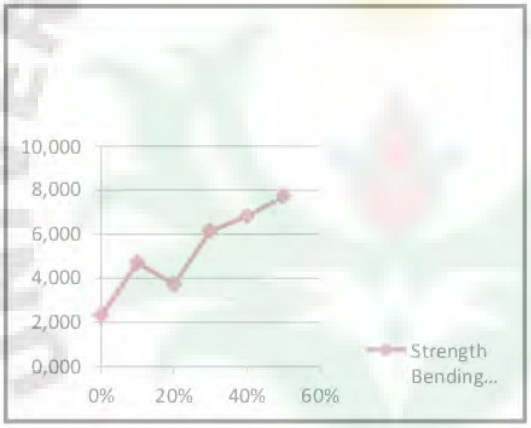

Figure 4. Composite Bending Strength

Based on data that is known bending strength 0% fiber variation of 2,329 MPa, 10% fiber variation of 4.698 MPa, 20% fiber variation of 3.739 MPa, variation 30% fiber is 6,151 MPa, fiber variation 40% as big as 6,809 MPa, and variation fiber 50% as big as 7,720 MPa. Strength flexible most low there is on variation 0 %, i.e., a sample consisting of 0% fiber and 100% polyester. Strong flexibility is the highest, in the 50% fiber variation that is as big as 7,720 MPa. On composite variation fiber, 20% strong, flexible experience drop that is as big as 3,739 MPa, and on variation, 30%-50% experience return increase. There is a decrease in This bending strength caused by a factor mixing Fiber which is not equal and not homogeneous, so that strong the bend decrease.

4. Conclusion

Influence addition variation fraction volume fiber to characteristics mechanic composite the more increase. Adding variations of coffee husk fiber and corn husk fiber makes the nature mechanic on composite polyester getting better; however, in variations, a 20% decrease score mechanic. Variation composite with score mechanic most tall is composite variation 50% with 50% fiber and 50% resin polyester with a strong Tensile as big as 8,321MPa, modulus elasticity 22,262 MPa,and strength bending 7,720 MPa.

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