COMPARISON STUDY OF PALM FIBERS IN PAINTING PUTTY TO REDUCE TEMPERATURE CONDITIONS

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ABSTRACT

A Composite is a combination of two or more materials that have different properties so that it becomes a new material with different properties. The materials used in this study were polyester putty and palm fiber. Composites are durable, rust-resistant, and very strong. The purpose of this study is to determine the tensile strength, analyze the surface of the specimen using a scanning electron microscope, and be able to reduce the temperature in the car room. In the manufacture of composite tensile test specimens, it refers to the A370 standard with a size of 200 mm x 20 mm x 3 mm. In the tensile test, the average maximum stress was 0.769 kgf/cm^2 and the average yield stress was 0.755 kgf/cm^2. The calorimeter test uses the ASTM D5865 testing standard so that the absorbed heat is 20.8269 ^{o}C. In testing the scanning electron microscope using the ASTM A673 testing standard with 1000 times magnification.

Keywords: composite, tensile test, calorimeter, SEM, natural fiber, palm fiber.

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1. INTRODUCTION

The development of composite material technology in the automotive industry is very fast in the world, especially in the manufacture of car bodies. This research uses natural fiber material, namely palm fiber which at this time has not been utilized properly by material experts, especially in the automotive field. [1]. The purpose of the study was to determine the value of composite tensile strength, composite structure, and ability to reduce the temperature of the vehicle. In this study, it has problem boundaries so that it avoids things that do not need to be discussed, namely calculating the temperature that can be reduced by using a calorimeter, taking tensile strength data obtained from the Tensile Test, analyzing the surface of the specimen using a Scanning Electron Microscope. Palm fiber is one of the natural fibers found in Sumatra and eastern Indonesia, where this fiber is very widely used to mix polyester resin materials to make products. In the world of material, Composite is one of the materials used to replace metal in various industries, because composites are lighter, resistant to corrosion, and relatively inexpensive, for example, car dashboards, and ship hulls [2]. In general, painting uses the Indonesian National Standard SNI 06-1124-1989[3]. Utilization of palm fiber in the material world, palm fiber is still rarely used in the manufacture of composite materials. But basically, the use of palm fiber in the manufacture of composite materials can have a good impact on the environment, because it can decompose naturally. Fiber treatment is given to increase the bond between the fiber and the matrix to improve the mechanical characteristics of the composite material, one example of which is tensile strength, bending test, and being able to absorb temperature well. The fibers taken by Arenga Pinnata Merr have advantages such as acid resistance, weathering resistance, and durability [4]. Inorganic compounds found in plants are analyzed as ash by burning the material to be tested at a certain temperature. The components found in plant ash are potassium, calcium, and magnesium [5]. Polyester putty is a putty that is used to smooth the surface of the workpiece and fill in dents/holes. Polyester putty is made from polyester resin, whereas plastic putty is a 2 component material that uses natural/organic peroxide as a hardener. Putty contains extender pigment and is used as a thick coating but has a rough texture. Tensile strength is a test to determine the resistance of the material to the applied force until the material breaks. The test results obtained from the tensile strength test, it is very useful for product design and engineering because from this test we can get data and graphs of the tensile strength of the material. Heat can be defined as heat energy possessed by a material. The amount of heat possessed by a material can be determined by measuring the temperature of the object. If the temperature of the object is high, then the heat contained in the object is very large, if the temperature of the object is low, the heat contained in the object is very small. The tool used to measure the heat involved in a chemical change or reaction is called a calorimeter [7].

2. EXPERIMENTAL PROCEDURE

In this study, the problem is to calculate the temperature that can be reduced by using a calorimeter, retrieval of tensile strength data obtained from the tensile test, and analyzing the surface of the specimen using a Scanning Electron Microscop. To get good results, it is necessary to make a step - the steps that will be taken to get a conclusion. The fiber used in the study was from Porsea Around Toba Samosir Regency. For the manufacture of composite specimens used fiber that has been milled with a size of 50 mesh as a filler, and polyester putty as a matrix/binding material. Where polyester putty cannot be hardened if the hardener is not mixed with polyester putty. The parameters used in this study include several variables including Sample A is 98%

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putty: 2% hardener, Sample B is 93% putty: 5 % palm fiber: 2% hardener, Sample C is 90.5% putty: 7 fiber palm fiber, 5 %: 2 % hardener and Sample D is putty 88 %: palm fiber 10 %: 2 % hardener. The chemical content contained in palm fiber is fiber which has a density of 1,136 grams/cm3, where the chemical content is in the form of 8.90% water content, 51.54% cellulose, 15.88% hemicellulose, 43.09% lignin, and 2.54% ash. The fibers of the fibers are cleaned of adhering dirt by using water. The fibers are dried by drying in the sun to dry. fiber fibers are cut into pieces with a size of ± 5 mm. Then the fibers are ground to a powder with a size of 50 - 70 mesh. Hardener is used as a hardener. A mold is a tool used to shape the specimen to be tested; this mold is made of acrylic material. Where the mold used is 200 mm x 20 mm x 3mm.

3. RESULTS AND DISCUSSIONS

This test is carried out using a tensile testing machine where this test produces data on the maximum strength of the specimen as well as a curve diagram of the strains and stresses that occur during the test. In this tensile test, a tensile test was carried out 9 times with different levels of material from the test of the four samples; it is shown in Table-3.1.

Table-3.1. Tensile test of the four samples.

No	Tensile Test	A Sample	B Sample	C Sample	D sample
1	Wide (mm)	12,910	13,070	12,740	12,190
2	Thick (mm)	3,680	3,590	3,890	3,540
3	Cross-sectional area(mm^2)	47,509	46,921	49,559	43,153
4	Force peak (kgf)	37,100	19,900	36,800	27,400
5	Maximal stress (kgf/mm^2)	0,781	0,424	0,743	0,635
6	Young's modulus(kgf)	108,262	69,042	83,260	71,574
7	Force yield (kgf)	36,100	18,800	36,400	27,000
8	Yield Voltage(kgf/mm^2)	0,760	0,401	0,734	0,626

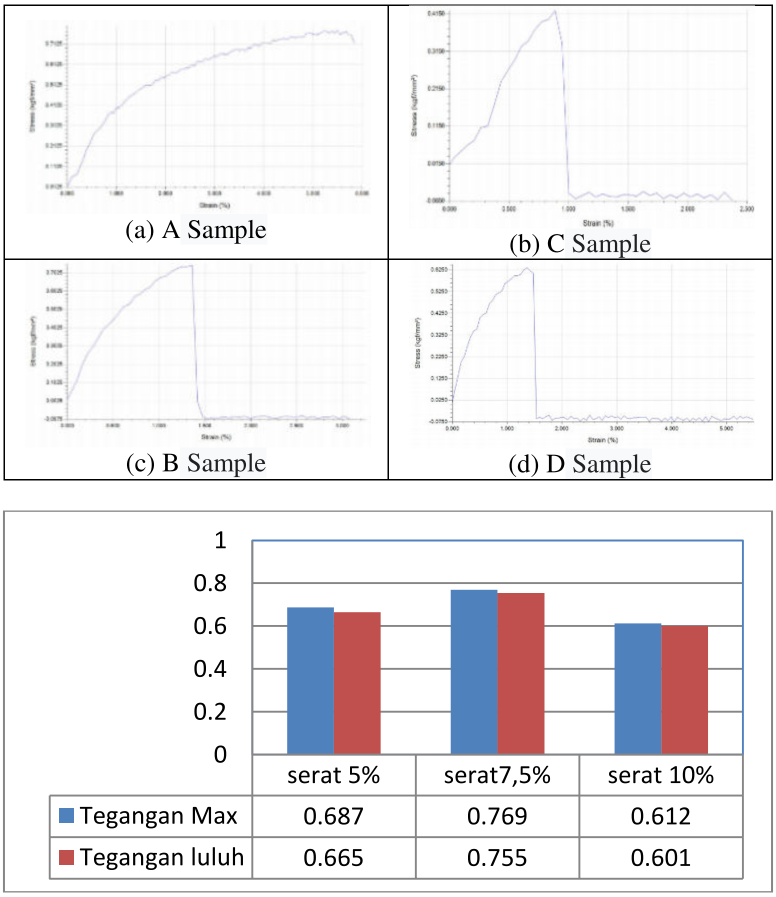

Figure-1. The tensile test of the sample and the average tensile test diagram.

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The average maximum stress in the tensile test in Figure-1.b is:

$$\sigma_y = \frac{1{,}108 + 0{,}530 + 0{,}424}{3} = \frac{2{,}062}{3} = 0{,}687 \text{ kgf/mm}^2$$

The average yield stress in the test in Figure-1.b is:

$$\sigma_y = \frac{1{,}094 + 0{,}502 + 0{,}400}{3} = \frac{1.996}{3} = 0{,}665 \text{ kgf/mm}^2$$

Then the average maximum stress in the test on sample C is:

$$\sigma_y = \frac{0{,}781 + 0{,}783 + 0{,}743}{3} = \frac{2{,}307}{3} = 0{,}769 \text{ kgf/mm}^2$$

The average yield stress in the test is:

$$\sigma_y = \frac{0{,}759 + 0{,}773 + 0{,}734}{3} = \frac{2{,}266}{3} = 0{,}755 \text{ kgf/mm}^2$$

$$\sigma_{max} = \frac{P}{A_o} = \frac{27{,}400}{45{,}114} = 0{,}607\ kgf/mm^2$$

In the tensile strength test of sample C carried out on the specimen it can be calculated the average value of the maximum stress and yield stress that occurs in the tensile strength test specimen are: Specimens with 10% fiber

The average maximum stress in the test on sample D is:

$$\sigma_y = \frac{0{,}607 + 0{,}597 + 0{,}634}{3} = \frac{1{,}838}{3} = 0{,}612 \text{ kgf/mm}^2$$

The average yield stress in the test is:

$$\sigma_y = \frac{0{,}600 + 0{,}580 + 0{,}625}{3} = \frac{1{,}805}{3} = 0{,}601 \text{ kgf/mm}^2$$

In Figure-1 it can be seen that the maximum stress that occurs in the 5% fiber mixture, the average maximum stress can be 0.687 $kg/^{mm2}$ and the average yield stress is 0.665 kg/mm^2, for a fiber mixture of 7.5%, the average value is - the average maximum stress is 0.769 kg/mm^2, the average yield stress is 0.755 kg/mm^2, while for a 10% fiber mixture the average maximum stress is 0.612 kg/mm^2 and the yield stress is 0.601 kg/mm^2. So in the tensile strength test carried out on the specimen, it can be seen that the highest maximum stress value of this test is found in the specimen which has 7.5% fiber with test results of 0.769 kg/mm^2 and the highest yield stress value is obtained at specimens that have 7.5% fiber with a test result of 0.755 kg/mm^2. While the smallest maximum stress occurs in the specimen with a 10% fiber mixture with a value of 0.612 kg/mm^2 and the smallest yield stress is found in 10% fiber with a value of 0.601 kg/mm^2.

Table-3.2. Calorimeter test on sample A.

Testing	Vessel	Mass (gr)	Qvad (cal/gr)	Jacket Temperature (°C)
Putty 98%	Vessel 1	1,3180	2369,03	17,9992

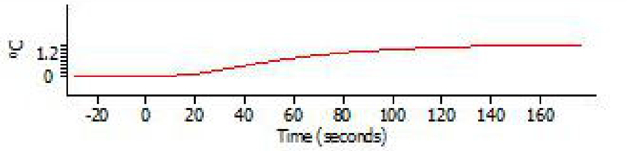

Figure-2. Qvad . Diagram.

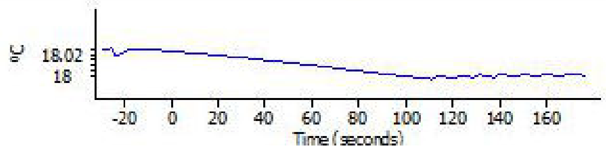

Figure-3. Graphs of Jacket Temperature °C.

In the tests that have been carried out, the ratio of 98% putty to 2% hardener can be calculated theoretically, the specific heat of the substance is as follows:

$$c = \frac{Q}{m \times \Delta T} = \frac{2369{,}03 \text{ cal/gr}}{1{,}3180 \text{ gr} \times 1 + 273{,}15 \text{ K}} = \frac{2369{,}03 \text{ cal/gr}}{361{,}3297 \text{ gr. K}} = 6{,}556 \text{ cal/K}$$

Table 3.3. Calorimeter test results for the surface of composite specimens with 93% putty, 5% palm fiber and 2% hardener.

testing	Vessel	Mass (gr)	Qvad (cal/gr)	Jacket Temperature (°C)
palm fiber 5%	Vessel 1	1,33220	2456,83	20,8269

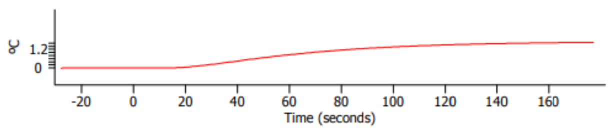

Figure-4. Qvad Graph (cal/gr).

Some tests have been carried out, and the ratio of putty is 93%: palm fiber 5%: and hardener 2%, so the

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theoretical specific heat of the substance can be calculated as follows:

$$c = \frac{Q}{m \times \Delta T} = \frac{2456{,}83 \text{ cal/gr}}{1{,}3322 \text{ gr} \times 1 + 273{,}15 \text{ K}}$$
$$= \frac{2456{,}83 \text{ cal/gr}}{365{,}22263 \text{ gr. K}} = 6{,}726 \text{ cal/K}$$

Table-3.4. Calorimeter test results for the surface of composite specimens with 90.5% putty, 7.5% palm fibers and 2% hardener.

Test	Vessel	Mass (gr)	Qvad (cal/gr)	Jacket Temperature (ºC)
palm fiber 7,5%	Vessel 1	1,2800	2522,93	18,0267

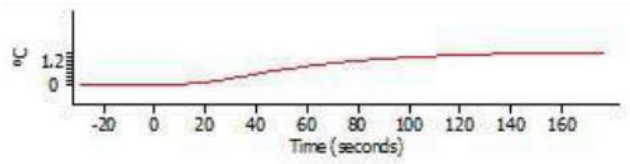


Figure-5. Graphs of Qvad Diagram (cal/g).

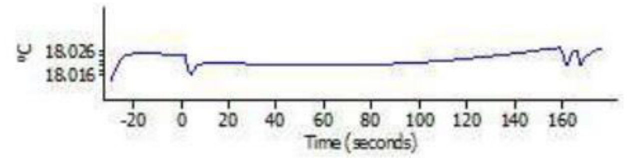


Figure-6. Graph of jacket Temperature (ºC)

Some tests have been carried out, and the ratio of putty is 90.5%: fiber 7.5%: and hardener 2%, so the theoretical specific heat of the substance can be calculated as follows:

$$c = \frac{Q}{m \times \Delta T} = \frac{2522{,}93 \text{ cal/gr}}{1{,}2800 \text{ gr} \times 1 + 273{,}15 \text{ K}}$$
$$= \frac{2522{,}93 \text{ cal/gr}}{350{,}912 \text{ gr. K}} = 7{,}19 \text{ cal/K}$$

Table-3.5. The results of the calorimeter test for the surface of the Composite Specimen with 88% Putty, 10% palm Fiber, and 2% Hardener.

Testing	Vessel	Massa (gr)	Qvad (cal/gr)	Jacket Temperature (ºC)
Palm fiber 10%	Vessel 1	1,1520	2501,28	18,0270

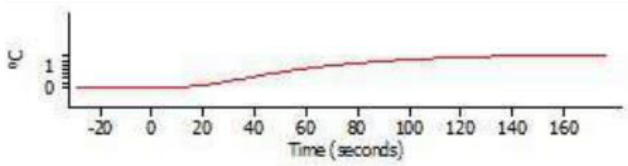


Figure-7. Qvad chart (cal/gr).

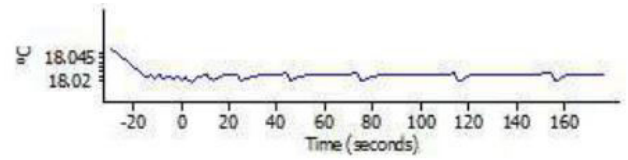


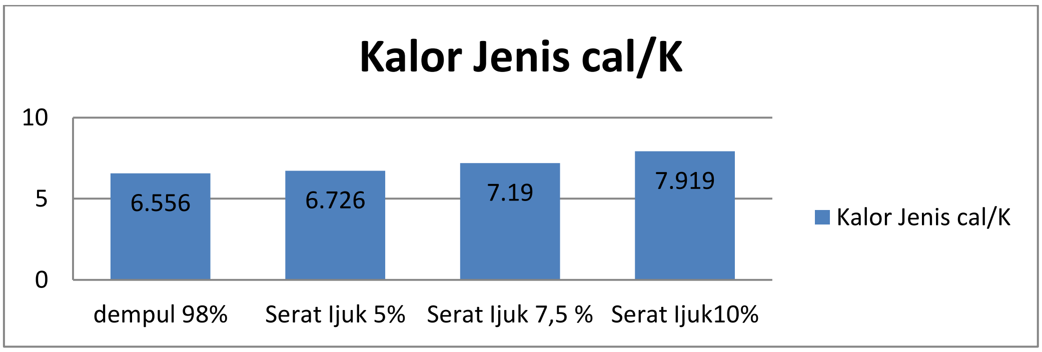
Figure-8. Jacket Temperature (ºC) graph.

Some tests have been carried out, and the ratio of putty is 88%; fiber 10%; hardener 2% then the specific heat of the substance can be calculated theoretically as follows:

$$c = \frac{Q}{m \times \Delta T} = \frac{2501{,}28 \text{ cal/gr}}{1{,}1{,}1520 \text{ gr} \times 1 + 273{,}15 \text{ K}}$$
$$= \frac{2501{,}28 \text{ cal/gr}}{315{,}8208 \text{ gr. K}} = 7{,}919 \text{ cal/K}$$

In Table-3.6, it can be seen that the specific calorific value which has the highest calorific value is the putty ratio of 88%: Fiber Ijuk 10%: Hardener 2%, while the lowest specific heat is in the ratio of putty 98%: 2% hardener.

Table 3.6. The average specific heat value on the calorimeter test/



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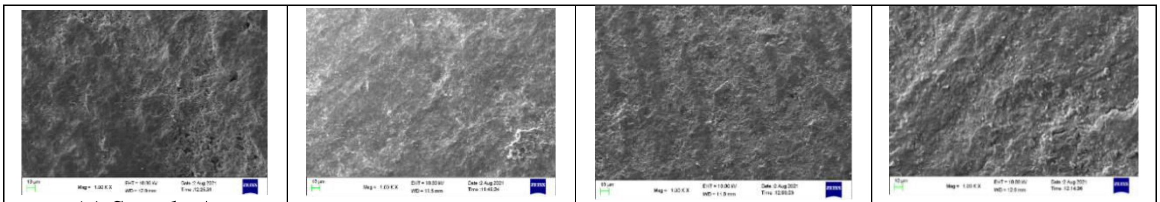
In the scanning electron microscope test that has been carried out on composite specimens, it is useful to see the surface structure of the specimen using a scale of 1000 times larger. In testing the scanning electron microscope using a standard test with ASTM E673. The test results obtained are as follows:



(a) Sample A | (b) Sample B | (c) Sample C | (d) Sample D

Figure-9. SEM Testing.

Based on the Figure above which is obtained in this test, it can be seen the photo of the microstructure of the ratio of 98% putty: 2% hardener. Where the surface of the workpiece has holes in it and a rough surface. In Figure 19(b) you can see the results of the Scanning electron microscope test with a photo of the microstructure from a ratio of 93% putty: 5% palm fiber: 2% hardener, obtained in the SEM test, it can be seen that the surface image does not look flawed but the workpiece must be compared to other workpieces. In Figure-19(c), you can see a photo of the micro-stricture from the ratio of 90.5% putty: 7.5% palm fiber: 2% hardener. From the picture above, it can be seen that the test object has a rough texture. In Figure-19 (d) the SEM test that has been carried out on the specimen shows that there are cracks in the specimen.

4. CONCLUSIONS

a) In the tensile test that has been carried out, the maximum stress that is closest to the putty stress is at 7.5% palm fiber with a maximum stress value of 0.769 kgf/cm^2 and a yield stress value of 0.755 kgf/cm^2.

b) In the calorimeter test that has been carried out, it can be seen that each addition of fiber with putty can reduce the temperature, but 5% fiber absorbs more heat by 20.8269 oC compared to other fibers.

c) In the SEM test, it can be seen that the mixture of palm fiber fibers has 5% more surface to be compared to other specimens.

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