The Effect of Fiber Size of Oil Palm Empty Fruit Brunches to the Tensile Strength of the Polymeric Foam Composite

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Abstract: ***The utilization of oil palm empty fruit bunches (EFB) as a composite material reinforcing fiber will have a very important meaning in terms of utilization of waste in palm oil factories. The purpose of this study was to obtain the strength value of tensile strength test of polymeric composite material of reinforced fiber of Palm Oil Empty Fruit Bunches (EFB) based on standard ASTM D-638 test. Preparation of specimen made of iron plate having a thickness of 4 mm width of 22.5 mm and length of 150 mm and also on both sides of the has a wall that uses transparent glass with a thickness of 5 mm. The composition used varies according to the specific gravity of the fiber, resins, and the material of the bubble / polyurethane, the addition of a catalyst to accelerate the hardening reaction of the composite material, by comparison of the composition A. 70% Resin, 15% EFB fiber, 15% Polyurethane. , B 70% Resin, 15% EFB Fiber, 15% Polyurethane, and C. 70% Resin, 15% Fiber EFB, 15% Polyurethane. For each composition of 3 specimens. The highest value of stress and strain using mesh 80 is 9.02 M Pa and strain value obtained 0,023 mm / mm. While the value of stress by using the mesh fiber size of 60 is 7.347 M Pa and the value of strain obtained is 0,022 mm / mm and the stress value by using 40 mesh fiber size is 7,127 and the strain value obtained is 0, 0213 mm / mm. From the result of testing the specimen A with the meshing size of 80 is better than the B and C specimens, each meshing size is 60 and 40.The smaller the size of EFB fibers in the composite material produces a higher tensile strength.***

Keywords: Composite Materials, Oil Palm Empty Fruit Bunch (EFB), Tensile Strength, Polymeric Foam

1. Introduction

The use of composite materials has a long history, was initially not known with certainty, but the historical record shows that the use of composite materials has been around since ancient Egypt where the straw is used to strong then the clay brick and wood that are arranged in layers to obtain resistance to expansion of the heat as well as address humidity [1], [2]. Empty Fruit Bunch (EFB) is a palm oil mill waste that number is very abundant. Each processing of 1 ton of Fresh Fruit Bunch (FFB) will be produced by EFB as much as 22 - 23% TKKS or as much as 220 - 230 kg EFB. Manufactory with a large capacity capable of processing 100 tons / hour in operation time for 1 hour, it will produce as much as 23 tons [3]. The nutritional content of oil palm EFB: C 35%, N 2.34%, C / N 15, P 0.31%, 5.53% C, 1.46% Ca, Mg 0.96%, and water 52 %.Empty Fruit Bunch (EFB) compost can be applied to various plants as organic fertilizer, either singly or combined with chemical fertilizer [3]. This research was conducted for the utilization of waste fiber pulp Oil Palm Empty Fruit Bunch (EFB) provided a lot and have been utilized partly as compost and this time will be processed as raw material composite generate economic value [4].

2. Method

2.1 Composite Materials

Composite is basically a combination of different materials on a macro scale.As examples of natural composite in nature is a composite wood cellulose fibers in a matrix of lignin. Composites are usually a combination of strong fiber materials such as glass fibers, carbon combined in a resin matrix such as epoxy or polymer. Excess composite it is adjustable.One way of setting properties of the composite material is by changing the direction of orientation, arrangement, and the angle of its constituent materials [5]. In addition, the composite is resistant to high corrosion and has a high resistance also to the load. Therefore, for the fiber material used strong, rigid, and brittle materials, the ingredients of the matrix are selected and soft materials [6].

2.2 Classification of Composite Materials

There are three types of composites that differentiate from other composites, namely composites reinforced by the form of reinforcement, the Particle Reinforced, Fiber Reinforced and Structural Composites

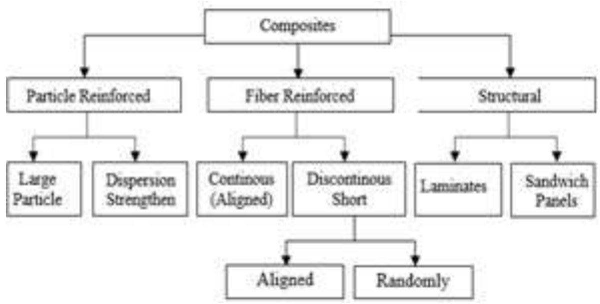

Figure 1: Classification of material composite

2.3 Mechanical Properties of Composite Materials

The mechanical properties are generally determined by destructive testing of samples of material at a controlled loading condition. In general, the properties of the composite is determined by several factors, among others: (a) the type of constituent materials, the fiber material to be used like coco fiber, palm fiber, pineapple fiber, banana fiber, and others. (b) The geometric shapes and structures of the constituent materials, the shapes of fibers, stacks, and structures of constituents in the manufacture of composite materials. (c) The ratio of composite materials, the ratio of materials to be used to produce new and good composite materials. (d) The adhesiveness of the constituent materials, is the ability of the fibers to bind each other between the constituents.(e) The manufacturing process, in this process, to consider steps to create a new material in order to obtain a good material and in accordance with the standards [7]-[9].

2.4 Polymeric Foam

Polymer is defined as a substance composed of molecules that include a series of one or more than one monomer unit. The polymeric foam is composed of solid phases and gases which are mixed together to form a foam. Plastic wrappers, plastic bottles, Styrofoam, nylon, and pipes include materials called polymers.This study uses a polymer as a mixture of fibers of oil palm empty fruit bunches.

2.5 Specimen Pattern

The specimen pattern is 150 mm in length and 4 mm in height and 22.5 mm in width. The specimen pattern is rectangular but has a rectangle on its end that serves as a holder for the tensile testing apparatus as shown in Figure 2.3. The process of making specimen mold is made from 5 mm iron plate that has been cut in shape with milling machine to rectangular shape with size according to ASTM D-638 standard.

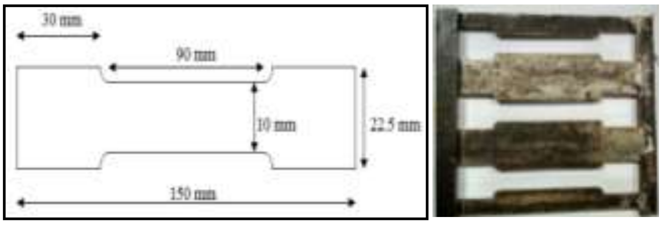

Figure 2: Tensile test specimen patterns ASTM D-638

2.6 Preparation of Fiber Oil Palm Empty Fruit Bunch (EFB)

Raw materials testing fiber specimen is oil palm empty fruit bunches (EFB) dried. The fiber material empty oil palm bunches taken just out of the engine boiling in the processing plant further wash with clean water washing until the oil content of the fiber palm empty fruit bunches of oil lost, to get better results soak fiber empty oil palm bunches for 24 hoursand mixed with a solution of NaOH show in figure 3.

Figure 3: Preparation of fiber oil palm empty fruit bunch

Investigation of EFB fiber by comparing the thermal and physical properties of EFB fibers treated with chemicals and those not being chemically treated. TGA & FTIR testing showed better thermal properties of EFB fibers treated with chemicals, as well as SEM & EDX physical properties also better of EFB treated chemically [11].Bionanocomposite hybrid polyurethane foam reinforced with EFB and nanoclay feedstocks has been performed [12] has a positive effect on improving the compressive strength and thermal stability of this composite material compared to the biocomposite which only uses EFB fibers but the production cost to make nanofibers and nanoclay is very high. The study of nanocomposites with epoxy as a matrix showed that the addition of 3% nano EFB as a filler was able to improve the physical, structural and thermomechanical properties of nanocomposites with epoxy as a matrix because of proper distribution and dispersion in the epoxy matrix[13].The addition of cellulose from EFB carried out on film biocomposites resulted in improved tensile strength and modulus of elasticity as well as good morphology in biocomposites[14].The study of the mechanical properties of woven braid fibers / empty bunches of hybrid palm oil reinforced polyhydroxybutyrate biocomposites as non-structural building materials. The results of tensile and bending test of hybrid woven fibers KBFw / EFB reinforced biocomposite polyhydroxybutyrate (PHB) with 11 layers have the ability as an alternative material to replace some wood species as non-structural building materials [15].

2.7 Specimen Testing

Tensile strength testing is often done because by knowing the tensile strength will be estimated several other material properties of hardness and ductility. The composition of the empty bunches of palm oil bunches that have been through the mixing process is then printed using the pattern provided. Figure 2 shows the specimens that have been printed and ready for the testing process. Specimen A is a fiber with a mesh size of 80 furthermore specimen B is a mesh size of 60 and specimen C is a mesh size of 40. Testing of fiber specimens of oil palm empty bunches using a tensile test, the test specimens follow ASTM D-638 standard. To obtain a strong composite material, the empty bunches of oil palm fibers are mixed with thermoset resins with constituent material as shown in Table 1.

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Table 1: Research materials

No	*Materials*	*Material Type*	*Information*
1	Unsaturated Resin polyester	BQTN 157-EX	
2	Empty Fruit Bunches (EFB)		fiber
3	Blowing Agent	Polyurethane	
4	Catalyst	MEKP	
5	Fiber cleaning	NaOH, 1M	1%
6	Special lubricant	WAX	Lubrication of molds and patterns

The material composition for each specimen to be tested can be seen in Table 1. For ABC specimens (show in Figure 4) the BQTN 157-EX Resin composition is 70% and the fiber composition is 15% and the polyurethane composition is 15% (Table 2).

Table 2: Research materials

Material	Composition (% Density)		
	A	B	C
ResinBQTN 157-EX	70	70	70
Fiber	15	15	15
Polyurethane	15	15	15
Total	100	100	100

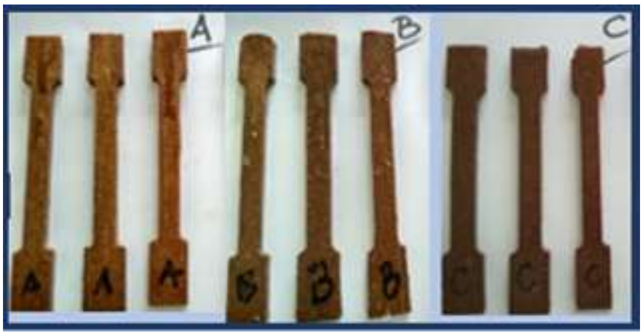

Figure 4: Specimens of empty fibers of oil palm

Analysis of mechanical strength in the form of stress and strain produced as a result of tensile testing that has been applied, of course influenced by the area of cross-section and the amount of change in length caused. The next test is carried out with the specimen is drawn on the upper side and lower side of the fiber pulp oil palm empty fruit bunches.

Figure 5: Specimen test equipment

3. Result and Discussion

The first test result on specimen A for meshing size 80. Figure 6 shows the graph of test result of specimen A showing the result of the mean stress8.86 and the value strain 0.03

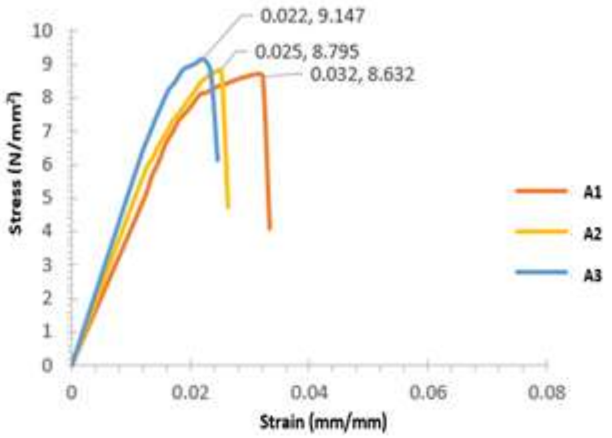

Figure 6: Result of specimen A with meshing size 80

The second test result on specimen B for meshing size 60 according to the composition of BQTN 157-EX 70% Resin, 15% fiber and Polyurethane 15% are shown in Figure 7. Figure 7 shows the graph of test result of specimen B showing the result of the mean stress7.33 and the value strain 0.02

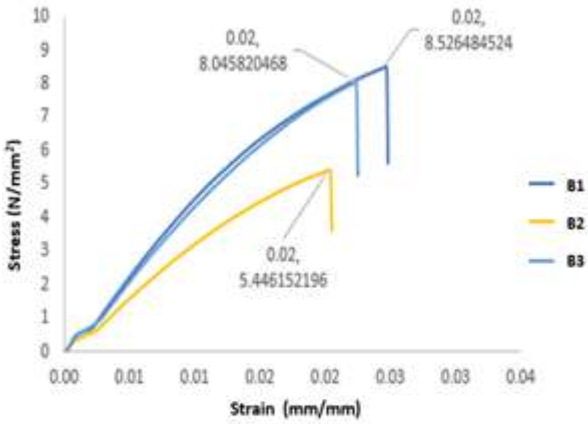

Figure 7: Result of specimen B with meshing size 60

The third test result on specimen C for meshing size 40 according to the composition of BQTN 157-EX 70% Resin, 15% fiber and Polyurethane 15% are shown in Figure 8. Figure 8 shows the graph of test result of specimen B showing the result of the mean stress7.09 and the value strain 0.02

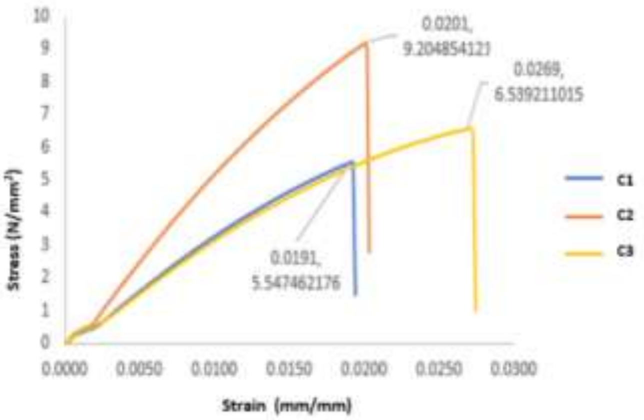

Figure 8: Result of specimen C with meshing size 40

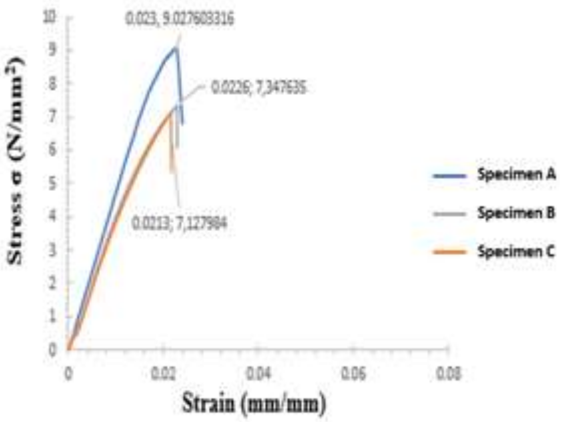

Figure 9: Result of comparison specimens A, B and C

Figure 9 shows a comparison of tensile specimens A, B and C. The curve shows that the specimen A (meshing 80) has the highest value compared to the specimen B (meshing 60) and the specimen C (meshing40).

4. Conclusion

From the data obtained shows that the tensile strength of specimen A is better than specimen B and specimen C with the value of each is A specimen voltage of 8.86 strain of 0.03, specimen B voltage of 7.33 strain of 0.02, specimen C voltage of 7.09 strain of 0.02 . From the data it can be concluded that the smaller the size of EFB fibers the tensile strength of composite materials the better. This is because the smaller the size of the fiber mixing between polyester resin and EFB fiber the better also.

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Author Profile

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