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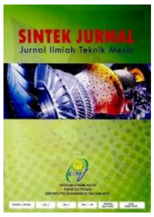

TESTING THE FLEXURAL PROPERTIES OF POLYMER COMPOSITES FOAMING HYBRID OIL PALM EMPTY FRUIT BUNCHES (OPEFB) AND ZINC OXIDE (ZnO)

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ABSTRACT

Oil palm empty fruit bunches (OPEFB) is one of the palm oil industry solid wastes that can be used as an alternative material to product composites. This research was conducted to determine the effect of the addition of Zinc Oxide (ZnO) as a filler material hybridized with OPEFB fiber to the flexural strength of polymeric foam composites. The aim of this research is to obtain the strength of the flexural test value of the composite material polymeric foam reinforced OPEFB fiber and Zinc Oxide (ZnO) with reference to the ASTM D790-92 standard. The composition of the specimens are 70% Resin, 15% OPEFB Fiber, 15% Polyurethane with different fiber sizes namely mesh (40, 60, 80, 100) and the addition of Zinc Oxide (ZnO) of (0%, 5%, 10%, 15%, 20%). The test specimen used for each composition is 5 samples, so that the entire test sample is 100 samples. From the test data it can be concluded the value of flexural strength in the 100 mesh OPEFB specimens and the addition of Zinc Oxide (ZnO) 10% is the best composition compared to 40, 60 and 80 mesh OPEFB with the addition of Zinc Oxide (ZnO) 5%, 15%, and 20%, where the voltage value is 10,01141 MPa and the strain value is 0,898456 mm / mm. From the research data it can also be concluded that the smaller the OPEFB fiber size with the addition of zinc oxidation (ZnO) 10%, the flexural strength of the polymeric foam composite material will be better.

Keywords: *palm oil empty fruit bunch; polymeric foam composite; flexural strength; fiber size; zinc oxide.*

1. INTRODUCTION

The use of composite materials as construction materials or components of a product is developing very rapidly at this time. This is due to the advantages possessed by composite materials, including low density, relatively large strength, and high economic value [1]. So far the industry still uses synthetic fibers which are generally in the form of fiber glass as materials that function as reinforcement. But the use of glass fiber that is relatively expensive. Glass fiber cannot be degradated naturally and its processing requires chemical processes [2]. The use of synthetic fibers as a reinforcement on composites is currently being abandoned. The textile industry is more likely to use natural fibers because it is more environmentally friendly, besides the availability of natural fibers that are very abundant and their use is still not optimal [3].

Natural fiber is an alternative composite filler for various polymer composites because of its superiority. Some of the advantages of using natural fibers in composite materials compared to synthetic fibers are low density, fibers made from renewable materials that require less energy to produce, lower manufacturing costs, less risk in the manufacturing process [4]. From so many natural fibers available, one of them is Oil Palm Empty Fruit Bunch Fiber (OPEFB) due to the availability of quite a lot of OPEFB in Indonesia.

Oil Palm Empty Fruit Bunch (OPEFB) is a very abundant amount of palm oil mill waste. Because each processing 1 Ton of Fresh Fruit Bunches will produce as many as 220-230 kg OPEFB. A large capacity palm oil mill is able to process 100 tons / hour in 1 hour of operation, it will produce 23 tons of OPEFB [5]. The potential of OPEFB waste especially in Aceh is also quite abundant, so another alternative is needed to utilize the OPEFB waste into a more efficient material [6]. OPEFB fiber also contains cellulose and holocellulose which is high enough to be feasible to be developed in materials technology, especially in the field of composite engineering. The effects of adding OPEFB fibers in the manufacture of composite materials include: lightweight, high mechanical strength and environmentally friendly. This fiber also functions as a reinforcement and increases the tensile strength so that it is more ductile than a composite in general. The OPEFB fiber used in the manufacture of composites has a high economic value besides being the result of palm oil mill effluents, this fiber is also easy to obtain, inexpensive, does not endanger health, and can be degrading naturally (biodegradability) [7].

This OPEFB fiber can be mixed with other materials such as zinc oxidation (ZnO). Zinc Oxide is an inorganic compound in the form of white powder, almost insoluble in water [8]. OPEFB blended with resin, polyurethane and catalyst to produce a new Polymeric Foam composite material that is reinforced by light and strong OPEFB fibers [9].

This study was conducted to determine the effect of the addition of ZnO as a filler material combined with OPEFB fibers against the flexural strength of polymeric foam composites.

The purpose of conducting this research is to get the best flexural strength and composition of composite materials by utilizing Oil Palm Empty Fruit Bunch (OPEFB) and Zinc Oxidation (ZnO) as composite fillers.

2. METHODS

The research method was started by preparing the tools and materials, after that continued with making OPEFB fibers and test specimens with the addition of oxidaseeng (ZnO), followed by testing to get the maximum strength value (figure 1).

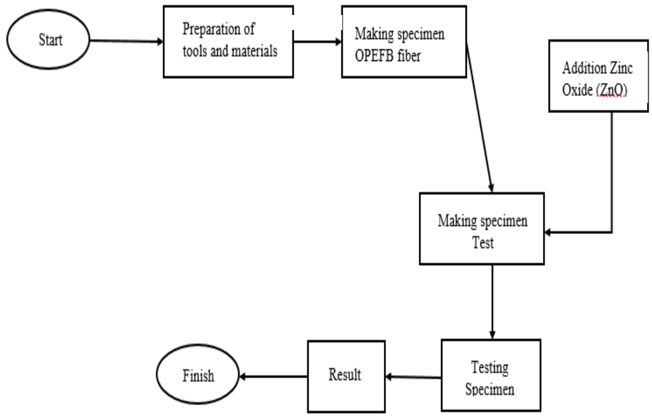

Figure 1. Schematic of the Research Process

2.1. Making Oil Palm Empty Fruit Bunch (OPEFB)

The raw material for specimen testing is oil palm empty fruit bunch fiber, where the OPEFB fiber is the main ingredients.

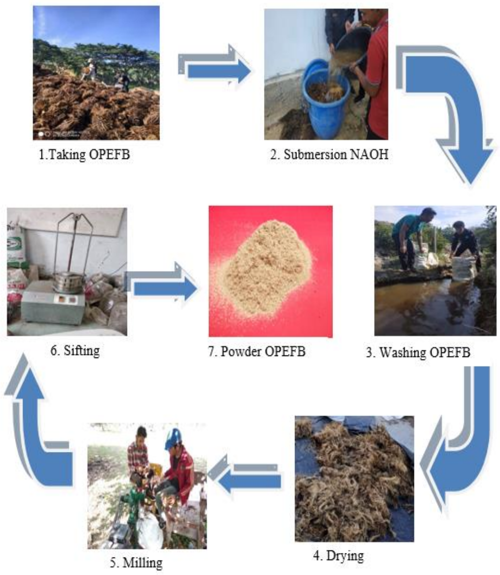

Figure 2. OPEFB Fiber Making Process

The OPEFB material is taken out of the boiling machine at the processing plant, then the OPEFB is cleaned by immersing it with NAOH solution for 24 hours in order to get better results. After the immersion process is complete, the OPEFB through the drying process. The drying process can be done by using solar heat or using a drying machine. After the OPEFB dries, a grinding and sieving process can be done to get 40, 60, 80, and 100 mesh.

The ZnO used in this study was in the form of white flour/powder with a density of 5.606 gr/cm^3 obtained from a chemical distributor and composite PT. Justus Sakti Raya.

2.2. Making Specimens

The fiber used is obtained from oil palm empty fruit bunch waste), where this fiber has a good strength value so that it can be utilized continuously because it is still not optimal in utilizing the OPEFB waste, which is very easily obtained by the process simple treatment.To get a strong composite material, OPEFB is also mixed with thermoset resin and constituent material as shown in table 1.

Table 1. Research Materials

No	Materials	Specification	Information
1	Resin Poliester not saturated	BQTN 157-EX	
2	oil palm empty fruit bunch		Fiber
3	Blowing Agent	Polyurathane	
4	Catalis	MEKPO	
5	Fiber cleanser	NaOH, 1M	
6	Special Lubricant	WAX	Lubricant
7	Zinc Oxide (ZnO)		White Powder

The composition of OPEFB fiber material that has been through the mixing process can be seen in table 2. The specimens to be tested for each composition amount to 5 test specimens.

Tabel 2. Composition of Test Specimen Material

Ingredients	Mesh	Composition (% Wt.)				
		1	2	3	4	5
Polyester Resin	40	70	70	70	70	70
Blowing Agent		15	15	15	15	15
OPEFB Fiber		15	15	15	15	15
Zinc Oxide		0	5	10	15	20
Ingredients	**Mesh**	**Composition (% Wt.)**				
		1	**2**	**3**	**4**	**5**
Polyester Resin	60	70	70	70	70	70
Blowing Agent		15	15	15	15	15
OPEFB Fiber		15	15	15	15	15
Zinc Oxide		0	5	10	15	20
Ingredients	**Mesh**	**Composition (% Wt.)**				
		1	**2**	**3**	**4**	**5**
Polyester Resin	80	70	70	70	70	70
Blowing Agent		15	15	15	15	15
OPEFB Fiber		15	15	15	15	15
Zinc Oxide		0	5	10	15	20
Ingredients	**Mesh**	**Composition (% Wt.)**				
		1	**2**	**3**	**4**	**5**
Polyester Resin	100	70	70	70	70	70
Blowing Agent		15	15	15	15	15
OPEFB Fiber		15	15	15	15	15
Zinc Oxide		0	5	10	15	20

The technique of making polymeric foam composite materials in this study uses the pouring / casting method into the mold after being evenly mixed using a mixer in a mixing container. This casting process is carried out to produce a hollow composite structure (foam) with random / non-continuous fiber direction as in Figure 3, so it cannot be done by hand lay up, where this method is used on long and continuous fibers.

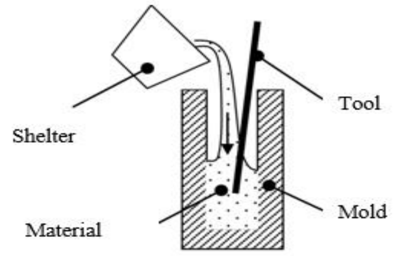

Figure 3. Composite pouring method

The process of making a specimen from beginning to end can be seen in Figure 4.

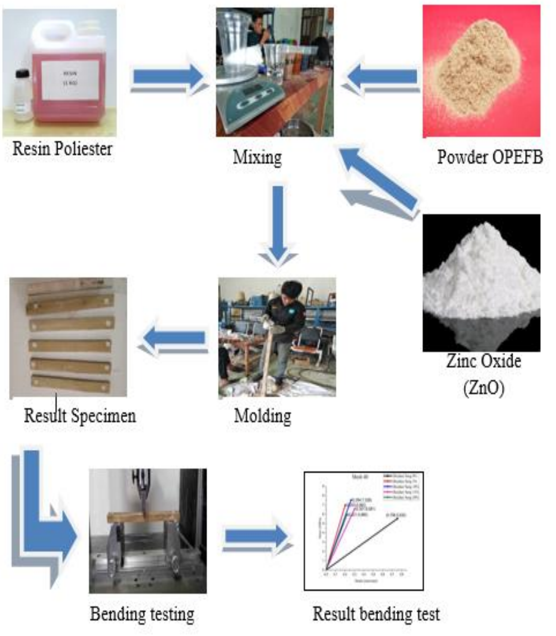

Figure 4. Specimen Manufacturing Process

Bending test on a material or structure is a load on a specimen by pressing to get results in the form of data about the bending strength of a test specimen, where the test specimen can be seen in Figure 5.

Figure 5. Bending Test Specimens

The size of the test specimen refers to the provisions of the American Standard for Testing and Materials (ASTM) where this study uses ASTM D790-92 so that the determination of the specimen size has been determined, the size of the test specimen can be seen in Figure 6.

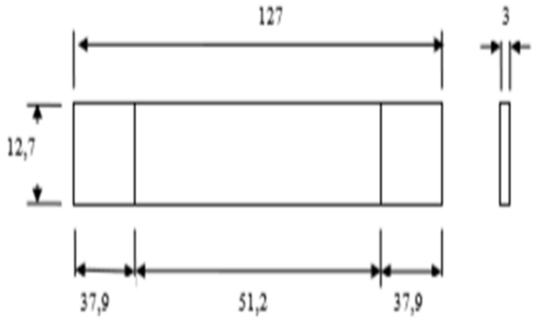

Figure 6. Size of the Bending Test Specimen

2.3. Testing Equipment

The equipment used for testing in this study is a universal tensile testing machine (RTF Series Bending Universal Testing Machine). Can be seen in Figure 7.

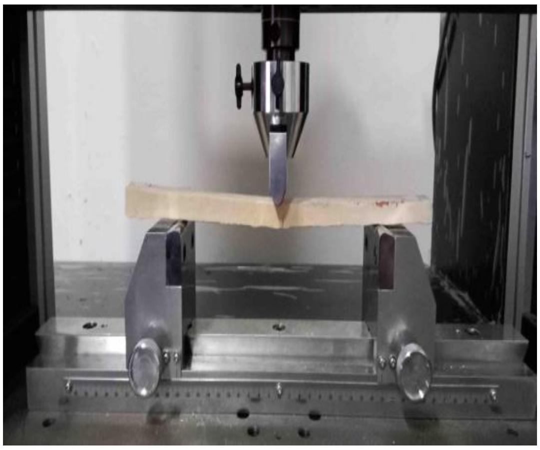

Figure 7. Universal bending test equipment

3. RESULTS AND DISCUSSION

The results of flexural tests carried out from several test samples can be explained in a diagram where the diagram explains the comparison of each test specimen average as can be seen in figure 8, is the average test results on the OPEFB mesh 40 fiber specimens and the addition of zinc oxide of 0%, 5%, 10%, 15%, and 20%.

The diagram shows the specimen with the addition of zinc oxidation (ZnO) 10% has a stress value of 7.528176 Mpa and a strain size of 0.264004 mm/mm.

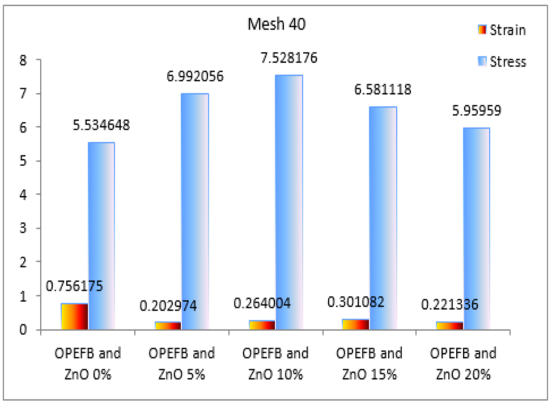

Figure 8. Stress / Structure Diagram in OPEFB Mesh 40 and ZnO specimens.

Figure 9 is the average test results on the 60 OPEFB mesh fiber specimen and the addition of zinc oxide of 0%, 5%, 10%, 15%, and 20%. Where the diagram shows that the magnitude of the specimen stress with the addition of zinc oxidation (ZnO) 10% is 7.66849 MPa and the strain size is 0.336219 mm / mm.

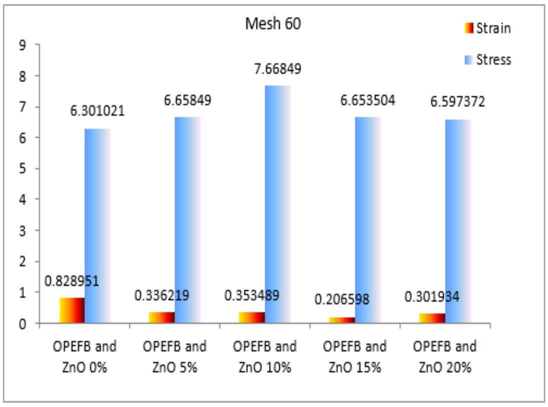

Figure 9. Stress / Strain Diagram in OPEFB Mesh 60 and ZnO specimens.

Figure 10 is the results obtained from testing the 80 mesh OPEFB fiber specimen where the addition of zinc oxidation (ZnO) 10% is the highest test value compared to the addition of zinc oxidation (ZnO) 0%, 5%, 15%, and 20% with a voltage value of 9,64639 MPa and reorganization value of 0.604701 mm / mm.

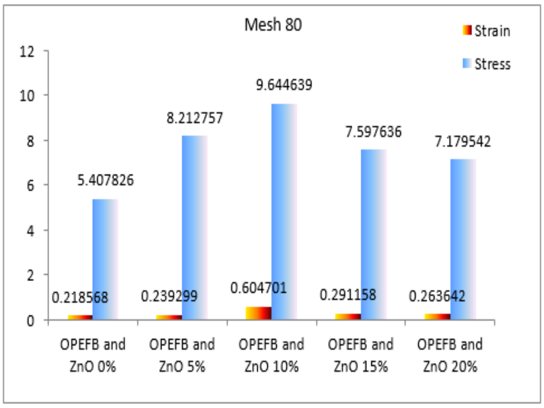

Figure 10. Stress / Strain Diagram in OPEFB Mesh 80 and ZnO 10% specimens.

The results obtained from testing the 100 mesh OPEFB fiber specimen with the addition of zinc oxidation (ZnO) 10% better than the addition of zinc oxidation (ZnO) 0%, 5%, 15%, and 20% where the value of the flexural stress is Mpa while the strain occurs at mm / mm, the value of the bending ratio can be seen in Figure 11.

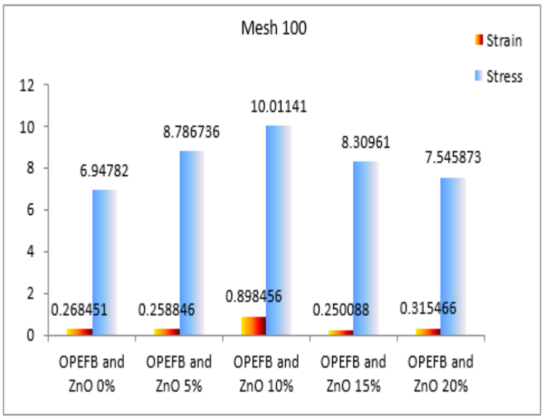

Figure 11. Stress / Strain Diagram in OPEFB Mesh 100 and ZnO specimens.

Figure 12 is a comparison diagram of the magnitude of stress and strain between 40, 60, 80, and 100 OPEFB fiber specimens, where the diagram shows the highest strain and stress values of each mesh.

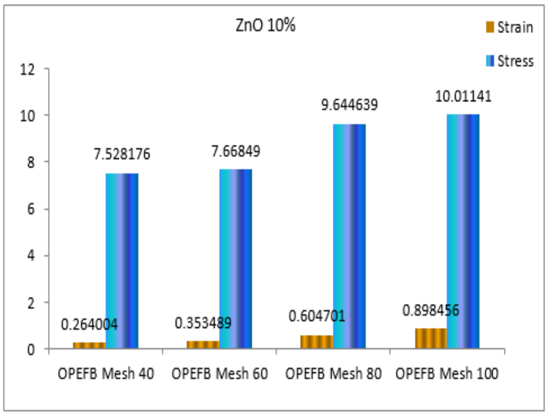

Figure 12. Tension / Strain Diagram in OPEFB Mesh specimens 40, 60, 80, and 100 with the addition of 10% Zn0.

4. CONCLUSION

From the test data it can be concluded the value of flexural strength in 100 mesh OPEFB specimens and the addition of zinc oxidation (ZnO) 10% is the best composition compared to 40, 60 and 80 mesh OPEFG with the addition of zinc oxidation (ZnO) 5%, 15%, and 20%, where the voltage value is 10.01141 MPa and the strain value is 0.898456 mm / mm. Through the research data it can also be concluded that the smaller the size of the OPEFB fiber with the addition of zinc oxidation (ZnO) of 10%, the flexural strength of the polymeric foam composite material will be better.

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