UTILIZATION OF PALM OIL WASTE WITH POLYPROPYLENE MATRIKS (PP) RECYCLING ON PARTICLE BOARD COMPOSITE (PARTICLE BOARD)

by Dedi Karni

UTILIZATION OF PALM OIL WASTE WITH POLYPROPYLENE MATRIKS (PP) RECYCLING ON PARTICLE BOARD COMPOSITE (PARTICLE BOARD)

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Abstract
Oil palm plants that have reached the age of no longer productive at the age of approximately 25 years should be done rejuvenation (replanting). The plant will become a waste that can be utilized optimally as a particle board so it is not wasted in vain. Research conducted on particle board composites reinforced with fiber-shaped palm rods and particles arranged with a polypropylene (PP) matrix of waste plastic bottles. The research stages were started from the selection of fibers, particle size, mixing and addition of Adiptif Maleic Anhydride (MAH) ingredients by 5% by weight of matrix and Benzoyl Peroxide (BPO) by 15% of MAH weight and particle formation, up to the testing stage. Composite particle board is made by hot press method. The composite particle board consisting of fibers / particles with polypropylene matrix (PP) measured its composite mechanical properties against bending strength with variation of volume fraction of oil palm rod - polypropylene (PP) by 60%: 50%, 50%: 50%, and 40% : 60%. The specimens and bending testing procedures refer to the ASTM D 790-03 standard. Testing of mechanical properties tends to increase with increasing adhesive (matrix) levels. The highest bending strength on particle board composites with a 40%: 60 composition of 13.01 N / mm^2 is higher than that of composite particle board with a composition of 60%: 40%, 50%: 50% of 11.17 N / mm^2. This research has obtained the right composition on the manufacture of particleboard that meets the SNI 03-2105-1996 quality standard. The results of this research is one of the solutions in the utilization of waste oil palm and recycled plastics so as to have a favorable economic value for the community around the palm plantation.

***Keywords**: particle board, palm oil rod, polypropylene.*

1. INTRODUCTION

1.1 Background

Increasing population growth makes human need for wood as construction of building or furniture continue to increase while wood willingness as raw material continue to decrease. According to the directorate general of forestry production development (Bakar 2003) that the last 5 years of timber production in the period of 2001 - 2005 ranged from 11 - 21 million m3 / year except in 2005 the production of logs reached 24 million m^3. This indicates that the demand for timber is increasing every year.

With the depletion of wood availability, then one effort that can be developed is the manufacture of composite board. Namely the manufacture of composites by using recycled plastics. The manufacture of composites with recycled plastics can have a good impact because in addition to improving the efficiency of timber utilization, it can also reduce the loading of plastic waste. The advantages of this product include cheaper production costs, raw materials abundant, flexible in the process of making and have better properties.

Simultaneously, the potential for palm oil is increasing at this time, with the growing extent of oil palm plantations in Indonesia. The high waste generated at this time because the utilization of oil palm is limited to the utilization of fruit, fiber, bunches and palm stem. While on the stem is generally burned or let it accumulate into waste that can cause various impacts and environmental disturbances.

The palm oil rods consist of two main components, namely vascular bundles and parenchyma tissue. The result of chemical analysis showed that the level of palm oil starch was high (Bakar, 2003). This starch can inhibit the gluing process on the particle board manufacture. One way to reduce this starch is by soaking the particles before the particles are processed further. According to Hadi (1991) and Afandy (2007) the cold soaking and heat immersion treatment of the particles causes a decrease in particulate matter, so that the contaminants present on the cell wall can be removed.

Meanwhile, the high plastic waste in each year continues to increase and will cause problems in handling the environment. Martaningtyas (2006) describes the plastic needs of the Indonesian community in 2002 around 1.9 million tons and then increased to 2.1 million tons in 2003, while plastic demand in 2004 was estimated at 2.3 million tons. This means that tens of tons of plastic have been produced and used by the community. Plastics have become an increasing number of life necessities that will impact the increase of environmental waste every year.

Polymers in general can increase the mechanical strength of composites. According to Jiang and Li 2017, the recorded statistics on particle board have identified the strength value of the optimum internal bond of 0.83 MPa representing the overall mechanical improvement of the particle board.

Polypropylene (PP), is one of the more rigid polymeric materials, has better tensile strength and clarity than Polyethylene and also low water vapor permeability and high Polypropylene melting point is 170°C. This material is widely used to make tools for everyday purposes, one of them on a glass of mineral water. Polypropylene is a recyclable plastic type that has the potential as a matrix in the manufacture of particle board composites because it is lightweight easily formed, resistant to chemicals.

Research conducted (Maryam [4] Jamilah Lubis, et al 2009) on the use of waste oil palm stem and recycled plastic Polyethylene (PE) as plastic composite board stated that the addition of MAH and DCP additives on the composite board resulted in improved physical and board quality on the ratio of 70: 30 particles and plastic compositions. These results have met the JIS A 5908 (2003) standard but only on testing their physical properties while in mechanical tests have not met the standard.

So here the author wants to do the development of previous research that is expected to increase the value of mechanical strength. The difference of this study with the research conducted (Maryam Jamilah Lubis, et al 2009) is to replace the matrix Polyethylene (PE) with a type of Polypropylene (PP) recycled plastic that has a tensile strength and clarity is better. Based on the above background, the authors want to conduct research with the title "Analysis of Bending Strength and Impact on Oil Palm Waste Trunk With Polypropylene Matrix (PP) Recycled On Particle Board Composite (particle board)".

2. METHODOLOGY

In this research and testing required some equipment and materials for workmanship as follows:

The equipment used in this study is as follows:

1. Test tool:
   The bending test aims to determine the combination of the quality of a material due to tensile, tap and shear loads.
2. Hot press printing tool aims as a hot press tool to print the particle board into a sheet.
3. Measuring tools: digital scales are used to measure the weight of each composition.
4. Screen 16 mesh: 16 mesh screen is used to filter the fiber of oil palm rod so that get particle granules.
5. Fan: the fan is used to assist or accelerate the cooling when finished in the heat.
6. Other Helping Tools: gloves, screwdrivers, chisels, aluminum foil, scissors, knives etc.

The materials used in this study are as follows:

1. Fibers of oil palm stalks that have been done several stages of treatment so that it can be taken fiber to be a test sample Impact and Bending. In this test there are 2 samples that is rough fiber fiber and fiber bar (Particle), can be seen in figure 2.1.

Figure 2.2 Fibers of oil palm stems

Figure 2.2 Particles of oil palm rods

2. Recycled plastic, the type of bioplastic used is glass plastic mineral water pack as powder binder particles of palm fiber rod fibers are polypropilene (PP) type.

Figure 2.3 Polypropylene Plastics

3. Maleic Anhydride (MAH), As an additive on particle board useful as compatibilizer, mixed fiber material with adhesive (matrix).

Figure 2.4 Maleic Anhydride (MAH)

4. Benzoyl Peroxide (BPO), As an initiator of polymerization on the manufacture of stirene polymers and

other resins, and plays an important role in the maleolation reaction between the PP chain and MAH.

Figure 2.5 Benzoyl Peroxide (BPO)

Volume Fraction Determination

Gambar 2.6 Cetakan

Based on the size of the mold above the printed volume can be calculated as follows:

V = Length x Width x Height (cm3) = 190 mm x 120 mm x 10 mm = 228000mm = 228 cm3

Table 2.1 composition of fiber and matrix raw materials

Fiber Trunk	Fiber levels (%)	Plastic levels(%)
Fiber	60	40
	50	50
	40	60
Particle	60	40
	50	50
	40	60

To calculate the weight percentage of palm fiber rod and the weight of the matrix that needs to be known is the volume of the mold. Printing equipment used in the manufacture of test specimens using printing presses located on a hot press machine whose size has been specified is () = 228 cm3, polypropylene () = 0.887 gr / cm3 matrix mass, and also the mass of palm fiber rod fiber () = 0.601 gr / cm3.
From the above results we can calculate the weight of fiber without plastic:
Mass = V mold × fiber
= 228 cm^3 × 0.601 gr / cm^3
= 137,028 gr

Weightless plastic plastics:
Mass = V mold × plastic
= 228 cm^3 × 0.887 gr / cm^3
= 202.236 gr
So to get the desired variations need to be calculated as follows:

□Specimen 1.
To obtain a specimen with a composition of 60% fiber and 40% plastic then:
Weight fiber 60% and 40% plastic, then:
Fiber = 60% × 137,028 gr
= 82.22 gr
Plastic = 40% × 202,236 gr
= 80.90 gr

□Specimen 2.
To get the specimen with the composition of 50% fiber and 50% plastic then:
50% fiber weight and 50% plastic, then:
Fiber = 50% × 137,028 gr
= 68.51 gr
Plastic = 50% × 202,236 gr
= 101.12 gr

□Specimen 3.
To get specimen with 40% fiber and 60% plastic composition then:
40% fiber weight and 60% plastic, then:
Fiber = 40% × 137,028 gr
= 54.81 gr
Plastic = 60% × 202,236 gr
= 121.34 gr

Composition of MAH and BPO (additive)

The addition of additives is essential in making good quality composite boards, adding additives of 5% by weight of Polypropylene to MAH, and to ODS by 15% by weight of maleic anhydride (MAH).

Then to get the desired composition can be calculated in the following way.

❑ Use of Maleic Anhydrid (MAH) as much as 5% of plastic weight, then.

Plastic 40% = 80.90 gr x 5% = 4,045 gr

Plastic 50% = 101.12 gr x 5% = 5,056 gr

Plastic 60% = 121,34 gr x 5% = 6,067 gr

❑ Use of Benzoyl Peroxide (BPO) as much as 15% of MAH weight, hence

MAH = 4,045 gr x 15% = 0,607 gr

MAH = 5,056 gr x 15% = 0,758 gr

MAH = 6,067 gr x 15% = 0,910 gr

Samples Preparation

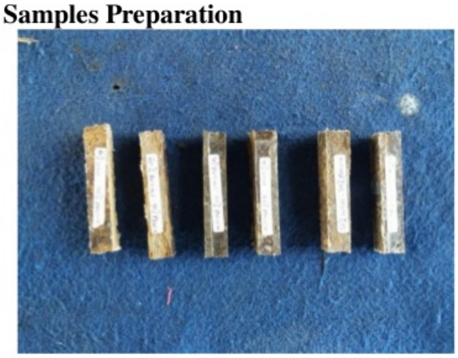


Figure 2.6 Sample impact test

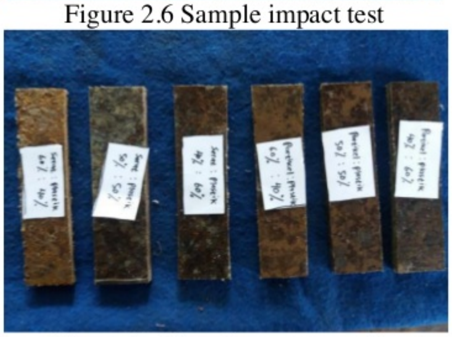


Figure 2.6 Bending test sample

Bending Test

Bending test standard used ASTM (America society of tenchichal and Matherial) D-790-03 (Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating materials).

Table 3.1 Result of bending test of the particle rod

	Area (mm^2)	Yield Strength (N/mm^2)	Bending Strength (N/mm^2)
particle 60%	420.900	0.27	3.87
particle 50%	406.413	0.47	9.89
Particle 40%	380.117	0.50	11.17

The method of bending test is done by Three Points of Bending method with the distance of 10 times thickness of specimen.

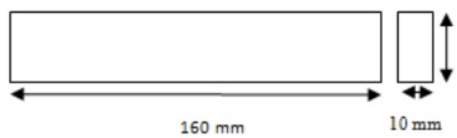


Figure 27 Bending test specimen size

Tabel 3.2 Result of bending test of fiber-rod

specimen	Area (mm^2)	Yield Strength (N/mm^2)	Bending Strength (N/mm^2)
Fiber 60%	400.050	0.40	7.31
Fiber 50%	363.330	0.55	10.34
Fiber 40%	338.000	0.50	13.01

3.TESTING AND PROCESSING DATA

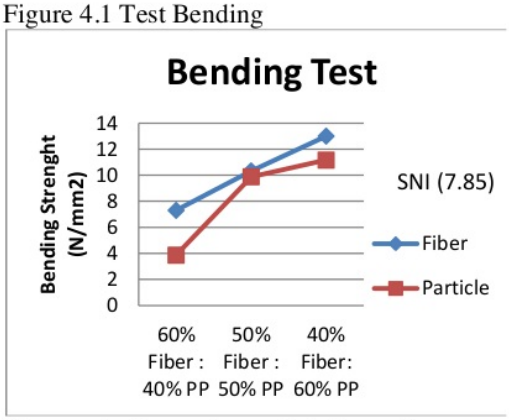
Table 3.1 Bending test results of oil palm stalk particles

Table 3.2 Result of bending test of fiber of palm stem

Figure 3.1 specimens of fibers and particles after bending test

4. ANALYST AND DISCUSSION

Figure 4.1 Test Bending



The graph above shows that the optimum particle bending strength of the particle board composite of palm fiber fibers is found in the fiber fraction: 40%: 60% matrix with Bending Strength 13.01, while the optimum value of the particle board composite of the oil palm stalk particles is in the fiber fraction: 40% matrix: 60% with Bending Strenght value 11.17. From the graph above we can conclude that in bending test of particle board composite between fiber and particle material when viewed from the highest value bending strenght particle board of palm fiber fiber is clearly stronger than particle board made from particle.

In boards made of fibers and particles we can see on the graph with increasing adhesive (matrix) then the strength of bending produced will be better this is because with the addition of adhesive (matrix) also means reducing the amount of fiber used, thus reducing the area and volume of fiber that can covered adhesive (matrix). The denser and wider the area of contact between the fibers makes the use of adhesive (matrix) to be more effective which will produce a better bending strength of the board therefore with the increase of the matrix will result in improved bending of the particle board.

In the above diagram it can be seen also that on fibers starting from the composition of 50%: 50% already meets the SNI 03-2015-1996 standards, as well as on composition particles starting from 50%: 50% already meet the SNI standard. The bending strength value of SNI 7.85 N / mm2 while the bending strength value on the particles of oil palm stems starting from the composition of 50%: 50% is (10.34 N / mm2) on the fiber and (9.89 N / mm2) on the particles.

specimen	Area (mm^2)	Yield Strength (N/mm^2)	Bending Strength (N/mm^2)
Fiber 60%	400.050	0.40	7.31
Fiber 50%	363.330	0.55	10.34
Fiber 40%	338.000	0.50	13.01

4. CONCLUSION

1. The bending test of particle board made of fiber material is stronger than particle board made of particle material with the highest bending strength value in fiber 13.01 N / mm2 whereas on particle material 11.17 N / mm^2 lies in the same composition that is 40% fiber: 60% matrix.
2. Addition of MAH and BPO additives on this particle board resulted in improved board quality with MAH composition of 5% by weight of plastic and BPO 15% of MAH weight.
3. On the strength of Bending particle board from palm oil stem waste both made of fiber and particles have fulfilled the requirements of SNI 03-2105-1996 standard, starting from the composition of 50% fiber: 50% matrix

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