Characteristic of appropriate material building partition board by utilizing waste oil palm trunk

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Abstract. Construction of high-rise buildings is currently flourishing implemented that serves as an office, hall, hotel, or home. High-rise buildings in general minimize the use of construction materials that has a heavy weight to reduce the building load and achieving efficiency. One of construction parts that can be minimized weight is a wall construction. The materials of partition wall which produced are glass, gypsum, concrete and wood. This research uses of wood fiber materials from oil palm trunks which have reached the age of replanting. It is constituted by the growing oil palm plantations and palm oil mills in Indonesia so that it will also increase waste produced. This research uses experimental methods to determine the mixture of adhesive and oil palm trunk fiber (OPTF) in order to reach the standards of strength by find out the physical and mechanical properties of the partition. The result shows that using ratio 70:30 of adhesive and OPTF reach the standard partition wall that serves as partition board and decorative panel.

1. Introduction

Partition in buildings are flexible room dividers. This partition serves as a separator between two spaces that had different functions, limiting people's views, and giving a sense of security in a different space. Many modern houses today have shifted to rely on columns as the main and only element of the structure. The role of the wall is merely as a partition or bulkhead. High-rise buildings always minimize the use of brick walls in order to reduce the load weight and as an effort to minimize construction costs.

Currently, there are a lot of choices for partition walls because they have the advantage of being light in weight and easy to install. Partition walls was not overloading the building structure so no additional load calculations are required. The other role of the partition wall than as a room dividing wall, partition walls can also be function as decorative accents to conceptualize interiors such as backdrops. This triggers the emergence of alternative substitute materials that are more varied. There are many kinds of partition materials used as room divider, including glass, gypsum, concrete and wood.

In this study, using replanted oil palm trunk fiber as a partition wall material regard to the growth of the agricultural sector in Indonesia, it can be seen that the planting of oil palm trees is increasing every year [1]. The impact of this growth is the result of production and waste. The utilization of replanted oil palm trunks is not widely known that it can be used as building materials. Most of the oil palm plantation owners just let the oil palm trunks that have been felled around their plantations to rot. Oil palm trunks

have fibers that are stronger than fibers for other composite material products [2]. However, the water content in the oil palm trunk is very high, namely between 219.9%-379.4% and the hardness of the trunk is between 64.3-137.3 kg/cm^2[3]. So, it can be concluded that oil palm trunks can be used as additional materials in building materials.

The purpose of this study was to obtain the value of the concentration of oil palm trunk fiber and adhesive that can achieve the strength of the partition board according to the standards of JIS A 5908-2003 and SNI 01-4449-2006.

2. Literature review

The standardization of partition wall characteristics will lead to a discussion of the quality of a partition wall. Partition walls are classified as particleboard, fiberboard or composite boards. This type of partition board is divided into several classes according to the quality and density of the board. In some types of standards issued by several countries, the outline is the same.

The test for the partition board for oil palm trunks refers to the combination of JIS A 5908-2003 and SNI 01-4449-2006 as follows:

2.1. Density

Density test is carried out by taking data on the weight of each test object (gr) using a scale. Then use the dimensional test data (cm^3) that has been done previously. The density value is obtained by dividing the weight of the test object by the volume.

2.2. Water content

The water content test was carried out by taking data on the initial weight of each test object and then drying it in an oven at a temperature of 103℃ for 24 hours. The cooling process is carried out using a desiccator to constant weight. The moisture content value was obtained by dividing the difference between the initial weight (g) and the oven-dry weight with the oven-dry weight (gr) multiplied by 100.

2.3. Water absorption

The method of carrying out the water absorption test of the test object vertically for 24 hours. Furthermore, it is placed on a blotting paper to remove water on the surface and then given a weight plate (3 kg) on the top of the test object for 30 seconds on each surface carried out alternately. The water absorption value is taken by weighing the test object in no more than 10 minutes.

2.4. Expansion of thickness

The thickness expansion test is carried out by measuring the thickness (cm) of the test object before immersion. The procedure for measuring thickness refers to SNI 01-4449-2006. Next, position the test object 3cm below the surface of the water horizontally for 24 hours. Then the test object is removed from the immersion, then measure the thickness (cm) of the test object after immersion. The thickness change value is obtained from the division between the difference in thickness change after immersion and before immersion by the thickness before immersion multiplied by 100.

2.5. Bending strength test and modulus of elasticity

This value is obtained by using the Three Point Bending Test which refers to JIS A 5908-2003 and SNI 01-4449-2006. Testing using a universal machine.

2.6. Perpendicular tensile strength

The perpendicular tensile strength value was obtained using a universal machine referring to JIS A 5908-2003 and SNI 01-4449-2006.

Indented to studies that are relevant to the utilization of oil palm trunks are using oil palm trunks with recycled plastic adhesive types into composite plastic boards. The average physical properties and MOR of this board reached the JIS A 5908-2003 standard, but the elastic modulus value did not meet the standard [4]. Another research is using polystyrene adhesive into particle board. The ratio of oil palm wood and polystyrene that reached the strength standard of SNI 03-2105-1996 was 60:40 [5].

3. Method

The first step of this research is to conduct a literature study related to the utilization of oil palm trunks. Furthermore, the oil palm trunks that have become solid waste of oil palm plantations are taken and cut into wooden blocks (see Figure 1). Then the preservation process is carried out by soaking the oil palm trunks in running water for one week then drying in the sun without touching the ground directly, if the trunks are dry, then they are coated with teak extract [6]. The process of collecting oil palm trunk fiber by using a crab machine and the variation fiber size you can see in figure 2. The shape of the length distribution of oil palm trunk fibers is classified as a continuous distribution model where this distribution model allows to reduce voids and increase density, it can be concluded that oil palm trunk fiber can be used as room partition board material [7].

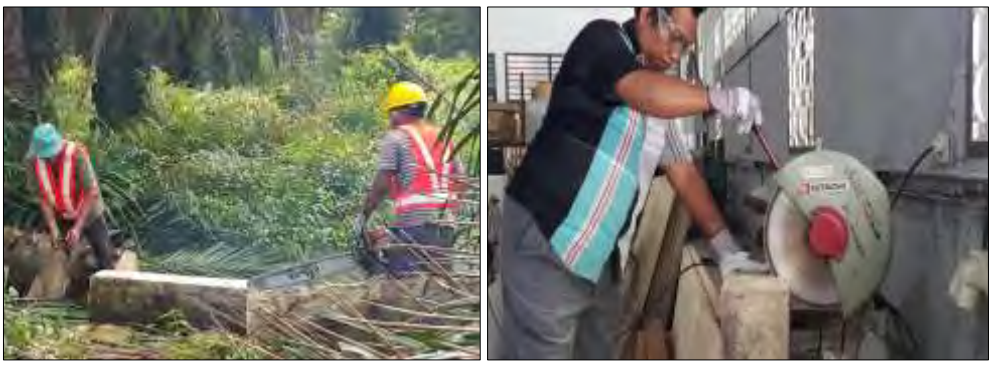

Figure 1. The process of cutting oil palm trunks into wooden blocks

Figure 2. Variations of the oil palm trunk fibers used for the manufacture of test objects

The next step is testing the density and moisture content of oil palm trunk fiber. The fiber used is fiber with a maximum moisture content of 8%. After that, enter the process of mixing fiber and adhesive materials. The urea formaldehyde powder is being used as adhesive. In this study, two kinds of comparisons were made, namely 40:60 and 30:70. Then printed using a hot press machine. The finished test object is allowed to stand for one week so that the evaporation temperature is perfect. Further testing of physical and mechanical properties is carried out based on applicable standards.

4. Results and Discussion

4.1. Physical Properties of Materials

The density value obtained for the ratio of fiber and adhesive 40:60 is 1.05 gr/cm^3 and the ratio of 30:70 is 1.07 gr/cm^3. Both of these density values meet the standards of JIS A 5908-2003 and SNI 01-4449-2006. In SNI 01-4449-2006 this density value belongs to the type of high-density board. In JIS A 5908-2003 this density value is classified as a board for decorative functions.

The value of moisture content obtained for the ratio of fiber and adhesive 40:60 is 15.36% and the ratio of 30:70 is 12.57%. Based on the requirements of JIS A 5908-2003 and SNI 01-4449-2006 show that the ratio of 30:70 meets the standard. The water absorption value obtained for the ratio of fiber and adhesive 40:60 is 18.17% and the ratio of 30:70 is 12.84%. Both of these water absorption values meet the standards of SNI 01-4449-2006. The thickness expansion in the ratio of fiber and adhesive 40:60 is 0.70% and the ratio of 30:70 is 0.37%. According to the requirements of JIS A 5908-2003, both samples met the standard.

4.2. Mechanical Properties of Materials

The average bending strength value of the ratio of fiber and adhesive 40:60 is 143.78N/mm^2 (1466.19kg/cm^2) and the ratio of 30:70 is 209.22N/mm^2 (2133.48kg/cm^2). The mean of modulus of elasticity for the ratio of fiber and adhesive 40:60 is 58.83N/mm^2 (599.93kg/cm^2) and the ratio of 30:70 is 176.56N/mm^2 (1800.45kg/cm^2). The mean of tensile strength value perpendicular to the surface of the fiber and adhesive ratio of 40:60 is 0.76N/mm^2 (7.79kg/cm^2) and the ratio of 30:70 is 0.758N/mm^2 (7.74kg/cm^2). According to the requirements of JIS A 5908-2003 and SNI 01-4449-2006, all of these test samples meet the standards.

Figure 3. The shape of the broken line that occurs in the Bending strength test and modulus of elasticity tests

Further research can test the installation technique of the material as a partition wall. The installation technique can use a dry hanging technique or direct installment to avoid a decrease in the quality of adhesion as a partition wall [8].

5. Conclusions

Based on the results and discussion, it can be concluded that the combination of oil palm trunk fiber and adhesive met the standards of JIS A 5908-2003 and SNI 01-4449-2006 on the properties of density, water absorption, thickness expansion, bending strength test and modulus of elasticity, and perpendicular tensile strength. However, on the moisture content strongly influenced bu the amount of fiber ratio by using this adhesive.

References

[1] BSN. Pertumbuhan sektor pertanian Indonesia. Indonesia: Badan Statistik Negara. 2015
[2] Sigalingging S R. Produksi dan Mutu Serat dari Batang Kelapa Sawit [Skripsi]. Departemen Kehutanan Fakultas Pertanian. Medan : USU. 2011.
[3] Iswanto A H, Azhar I, Coto Z, Febrianto F. Sifat Fisis dan Mekanis Batang Kelapa Sawit (Elaeis guineensis Jacq) Asal Kebun Aek Pancur-Sumatera Utara. *Jurnal Ilmu dan Teknologi Hasil Hutan* **3(1):1-7**. 2010.
[4] Wardani L, Massijaya M Y, Machdie M F. Pemanfaatan Limbah Batang Kelapa Sawit dan Plastik Daur Ulang sebagai Bahan Baku Papan Plastik Komposit. *Jurnal Ilmu dan teknologi Kayu Tropis* **10(1):51-59**. 2012.
[5] Mawardi I. Mutu Papan Partikel dari Kayu Kelapa Sawit (KKS) Berbasis Perekat Polystyrene. *Jurnal Teknik Mesin* **11(2):91-96**. 2009.

[6] Sutrisno, Kinanti W, & Ameilia Z S. Durability of Fiber Oil Palm Trunk Using Extract of Tectonia grandis (Jati). Seminar Nasional & Expo 2016. Medan: USU. 2016.
[7] Kinanti W, Ameilia Z S, & Sutrisno. Pleriminary Study of Sieves Analysis of Fiber Oil Palm Trunk Which Potential as Building Material. *IOSR Journal of Applied Physics (IOSR-JAP)* **8(4): 45-47**. 2016.
[8] LiBin Xu, Shangwei Chen, Xinzhou He & Guoliang Zhu. Research on Reasons for Repeated Falling of Tiles in Internal Walls of Construction. *IOP Conf. Ser.: Mater. Sci. Eng*. **317** 012065. 2018

Acknowledgments
Thanks to the Universitas Negeri Medan Research Institute through the competitive grant research project financed from the DIPA research decentralization DP2M Dikti with contract number 022A/UN33.8/KU/2016 dated 10 February 2016 so that this research can be carried out.