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Leaves Waste Composite with Glass Fiber Reinforcement

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Abstract. A research has been made to fabricate leave waste composites and Polyvinyl Acetate (PvAc) polymers reinforced with glass fibers. The method used was a simple mixing of leaves powders, PvAc, and glass fibers varied from 0 g to 1 g. Mass of 16 g leaves powder and mass of PvAc 4 g. The mixing result is suppressed by 5 metric-tons for 15 minutes. The composite is dried at room temperature for 1 day then in the oven at 100°C for 1 hour. The compressive strength is measured by a hydraulic press. The result show that the compressive strength increased to the highest point of 0.8 g and will decrease significantly when the addition of glass fiber mass of 1 g. The highest compressive strength reaches 52.6 MPa when the glass fiber mass is 0.8 g. The result of this research showed that leaves composites with Polyvinyl Acetate polymer reinforced with fiber glass can be used as alternative material of wood substitute.

1. Introduction

The demand for household goods and wood-based buildings continues to increase along with population growth. The massive supply of timber needs has seriously affected the destruction of forests and forests. On the other hand there begins a collective awareness of the need for greening as a guardian of world air quality [1]. This condition causes wood-based industries to experience serious problems of wood raw material scarcity which causes raw material prices to become very expensive and environmental issues that make wood-based industries become the main suspects in the rapid process of environmental damage [2]. At the same time the production of organic and inorganic waste as a consequence of waste of life activity is increasing. One of them is leaves waste that has not been studied and interesting for research. In Indonesia as a tropical country, leaves waste is very abundant. During this leaves waste only in the pile and burned and a small part for compost. The problem in this research is how to use leaves waste as wood substitute [3].

One of the answers to the above problem is by processing leaves waste into wood substitute material, it has a function that is strategic and very promising for our nation that is in tropical area. On the other hand, this idea will be one solution to the abundance of leaves waste and on the one hand will save the use of wood, so hope will be able to maintain environmental sustainability[4].

Since the use of more wood in some sectors triggered the amount of waste sawdust. In addition, the utilization of leave waste still not optimal [5]. It is necessary to support the implementation of appropriate technology that is expected to increase productivity. The use of press machine is helpful for improving product quality and mechanical properties of a product [1]. Based on these problems try to be approached by making composite leaves and Polyvinyl Acetate polymer reinforced with glass fiber.



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2. Experimental

The dried leaves waste used is mahogany leaves. It is destroyed with a blender until it becomes a fine powder. Next PVAc was weighed and dissolved in 8 ml of water and stirred using magnetic stirrer for about 15 minutes. The leaves waste powder and PVAc are then added with varying glass fibers, while the mass of leaves powder and PVAc remains 16 grams, the mass of PVAc 4 grams, and glass fiber varied from 0-1 grams. The effect of the addition of glass fiber to improving the strength of the material. Furthermore, from the various variations are sought on how many mixtures will be produced the most powerful materials. After leaves powder, PVAc and glass fibers are evenly mixed, then sample put into the mold and then pressed using a pressure of 5 metric-tons for 15 minutes. The composite is dried at room temperature for 1 day then in the oven at 100°C for 1 hour.

The compressive strength is measured using a hydraulic press tool in the Physics laboratory of Semarang State University.

3. Result and Discussion

3.1. The result of compressive strength

The results of the composite sample compression test with fiber glass filler obtained the data such as Table 1.

Table 1. Test results of composite leaves sample with glass fiber filler

Sample	Fiber glass (g)	Compressive strength (MPa)
A	0	17.0
B	0.2	32.3
C	0.4	36.4
D	0.6	48.6
E	0.8	52.6
F	1	37.4

3.2. The Effect of fiber glass

Properties of Powdered Leaves Although it has been done in hot-pressing still has a very high porosity, to increase the strength of leaves waste composite materials required polymer as a binder. The addition of PVAc will make the composite material strength stronger and lighter [7].

Furthermore, strength testing was done by adding fiber glass to the powder and PVAc mixture. From the results of sample tests on the sample table 1, where the results of its strength increased after the mixture of leaves powder and PVAc in add 0.2 gram glass fiber. This increase can be explained by the polymer impregnation approach. In the process of infiltration, penetration or polymer insertion into the pivot particles, the interaction between waste and polymer with fibers glass, fibers glass has increased the number of surface interactions that were originally only polymers with leaves particles, now added harder fibers glass so as to further enhance the mechanical strength of the material product. The presence of a shaft in leaves powder and PVAc after hot press allows for increased impregnation after added fiber glass. As a result the pore pores become smaller due to increased interaction between polymer surfaces with leaves particles. This decrease in pores is followed by increased interaction between polymer particles and waste fillers due to the proximity of the distance between them.

The addition of polymers and fibers glass to the leaves powder has a function as a particle binder. Initially the increase in composite compressive strength continues to increase in line with the addition of glass fibers from glassless samples of glass in add 0.2 grams up to 1 gram, while the mass of leaves powders and PVAc always remain in number. The maximum compressive strength is obtained when the fiber glass mixture is 08 grams, it is assumed that the mixed composition is mixing with the most

suitable composition, under these optimum conditions, the surface area of the interaction between the particles reaches the maximum point, where all the right particles interact effectively. The addition of either a fraction, either leaves powder or PVAc or fiber glass will have an impact on the addition of an unintended region. This is the cause when the addition of fiber glass with a mass of 1 gram, causing the composite strength decreased [8], [9], [10]. Wherein the increase of the fibers glass tends to increase composite strength of the compound produced through a certain fraction of 0.8 gram. The addition of fiber glass fraction actually decreases composite compressive strength. Fiber Glass fraction 0.8 is called the maximum fraction.

3.3. The influence of hot pressing

The process of impregnating fibers glass into the pores of the powder mixture and PVAc is strongly influenced by temperature and pressure [10]. An increase in pressure and temperature will allow for a more effective contact between the Adhesive surface and the surrounding Adherent surface resulting in an increase in mechanical strength [11]. With a decrease in the Polymer viscosity value, the penetration rate into the pores will become even faster [12]. The introduction of polymers into pores results in increased density and composite density. These conditions have an impact on increasing the mechanical strength of the resulting composite material [13] so that the higher the temperature gives the greater the compressive strength produced.

In addition to temperature, impregnation is also affected by pressure. This pressure affects the process of impregnation of leaves powder and PVAc with fiber glass. Pressure in principle as a speeding penetration glass fibers on leaves powder and PVAc. At the same temperature, increased pressure results in an increase in penetration rate. Pressure also causes the distance between the particles closer, the porosity decreases, the density increases and the particle arrangement becomes more solid so that the overall surface interaction between the particles also increases. This condition results in an increase in mechanical compressive strength of the resulting composite material.

4. Conclusion

Based on the discussion, it can be concluded that the powder of garbage leaves added by PVAc and fiber glass can effectively be processed into a strong and light composite material. The addition of fiber glass to the leaves powder and PVAc has a function of strengthening the resulting composite pressure. The maximum composite pressure is obtained when adding fibers glass is 0.8 grams. Leaves composites with Polyvinyl Acetate polymers reinforced with glass fibers provide an alternative to wood substitutes.

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