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Physical Properties Of Particle-Reinforced Particle Board And Gaba Fiber Using Pvac (Polyvinyl Acetate) Filler

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Abstract. Traditional materials are often selected and used in the construction of houses and buildings based on local knowledge that has been tested for centuries. The use of sago leaf stalks as a building material has several advantages. They are generally easy to find in tropical areas and have natural properties that allow good air circulation, thereby helping to keep the indoor temperature cool. In addition, this material is also environmentally friendly because it can decompose properly and can be renewed naturally. In an effort to preserve these cultural and traditional values, we can take several steps. First, public education and awareness about the advantages of traditional building materials need to be improved. Organizing workshops or seminars to share knowledge about the use of traditional materials and their benefits can help increase people's appreciation of these materials. The use of sago stalks as building materials can be part of cultural conservation and environmental preservation efforts. By combining traditional knowledge with modern innovation, we can create building solutions that are environmentally friendly, sustainable and maintain our cultural heritage. By using PVAc filler, this study aims to study its effect on the physical properties of the resulting composite material. Variations in the composition of the mix will enable the identification of changes in the characteristics of the composite board and efforts to obtain optimal physical properties.

Keywords. PVAc Filler, Sago stalks, Composite Fiber Particles

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1 Introduction

The rumba plant or Metroxylon sago Rottb, which is also known as the sago plant, is a plant that thrives in freshwater swamp areas. and a wide distribution, in Indonesia in various regions such as the islands of Sumatra, Kalimantan, Sulawesi, Papua, and the island of Halmahera, North Maluku (Flach, 1997)

Sustainable use and good management need to be implemented to maintain the continuity of sago plants and their benefits for the local community. The sago plant has long been used by the community as a building material for traditional houses in various regions of Indonesia. The use of leaves as roofing material, and leaf stalks as walls and ceilings is a common practice in traditional house construction in these areas, (Samad et al., 2017), the use of stalks of thatched plants as walls of buildings is still simple, in a cool way, and in today's modern practice, people rarely use it as a construction material. This is due to the development of technology and building materials that are more modern and efficient available in the market.

Often considered logging waste. This can happen because of lifestyle changes, changes in people's preferences for building materials, as well as the availability of alternative construction materials that are easier to obtain. It is important to remember that the use of traditional building materials, including sago leaf stalks, has cultural and traditional values that are important to maintain. (Samad et al., 2022). Along with the times, the use of sago leaf stalks as building materials has been reduced and even neglected, so they are but in the context of security, efficiency, and environmental sustainability, people can look for more modern and safer solutions in building houses or building structures.

Offers the potential to produce materials with good strength and properties. This research is a continuation of the previous research but with the use of a different filler, namely white glue Poly Vinyl Acetate (PVAc), to see the physical properties of the composite material using particles and fibers of sago leaf stalks. Poly Vinyl Acetate (PVAc) is a thermoplastic polymer, in the form of a solution or emulsion as a homopolymer or copolymer, an adhesive for wood and its derivatives. (Hanif & Rozalina, 2020), The matrix functions as a binding material that surrounds and holds the reinforcing material. Reinforcing materials can be fibers, particles, or powders that give strength and special properties to composite materials. The development of composite materials using particle fibers from sago leaf stalks PVAc is a polymer that has strong adhesive properties and is odorless, non-flammable and dries quickly and is solid, PVAc is also used as a matrix in the manufacture of composite material matrices.(Masturi, Mikrajuddin, 2010). From the main issues above, this study uses particle fiber from sago or gaba-gaba leaf stalks as the main material for the development of composite materials. Composite materials generally consist of a binder matrix and a reinforcing material. In this study, the density of the mixture of particles, matrix, and filler will be varied to produce a composite board with the expected

characteristic changes. By using PVAc filler, this study aims to study its effect on the physical properties of the resulting composite material. Variations in the composition of the mix will enable the identification of changes in the characteristics of the composite board and efforts to obtain optimal physical properties.

This study aims to gain a better understanding of the potential use of sago leaf sprigs as a filler in composite materials using PVAc as a filler. Thus, this research can contribute to the development of more sustainable and efficient building materials, by utilizing available natural materials.

Particle board standards based on Indonesian national standards SNI 03-2105.2006 and Japanese International standards, JIS A 5908.2003 and ASTM 2014 the physical properties of composite boards can be described in the following table:

Table 1. Particle Board Standard

No	Mechanical physical properties	SNI 03-2105-1996	JIS A 5908-2003	ASTM 2014
1	Density (gr/cm ³)	0.5-0.9	0.4-0.9	1.5-0.9
2	Water content (%)	<14	5-13	5-13
3	Water Absorbency	Maks 12	Max 12	Max 12
4	Thickness Development (%)	5-25	5-25	5-25

Source : (SNI.03-2105, 2006),(JIS A 5908:2003, 2003), (ASTM, 2014).

Similar studies, using fiber glass filler/matrix and epoxy as adhesives, obtained the results of the physical properties of particle composite boards, including:

Table 2. Particle Composite Boards

No	Mechanical physical properties	Fiber Glass	Epoxy
1	Density (gr/cm ³)	0.45	0.21
2	Water content (%)	11.0	9.30
3	Water Absorbency	12.0	6.8
4	Thickness Development (%)	6.95	3.97

Source : (Samad et al., 2017), (Samad et al., 2022).

Composite fiber particle boards using resin and epoxy catalysts has advantages in the physical properties of composite boards, where the physical properties meet SNI, JIS, and ASTM standards and are even better.(Samad et al., 2017), while for particle composite boards using a fiberglass filler/matrix, the physical properties also meet SNI, JIS, and ASTM 2014 standards, which are standards for the physical properties of composite boards for production (Samad et al., 2022).

Polyvinyl acetate adhesive has advantages including; being easy to use, the adhesive is very strong, the color is transparent, durable, resistant to microorganisms, can cover cavities.(Hanif & Rozalina, 2020).

The density of the composite particle board composite board, the higher the value of the firmness.(Sum, 1979)

2 Research Methods

This study used the following tools: a sago stalk crusher machine, a sago leaf stalk peeler, a press, a drying oven, digital scales, and measuring calipers.

The materials used are; Fibers and particles of sago leaf stalks, and white Poly Vinyl Acetate (PVAc) glue.

The material taken in this study was the same as in previous research, namely, the sago leaf stalk on the fruiting sago tree species, with a diameter of 3 cm – 10 cm and a length of 120 cm, then the skin of the leaf stalk was removed and then crushed and separated particles and fibers. The particles and fibers are mixed with PVAc adhesive, with a ratio of 1.5-3 Kg particles: 1-2 Kg fiber: 0.5-3 Kg PVAc, and printed with dimensions of 30 cm x 30 cm with a thickness of 2 cm. Making test samples in this study made 5 kinds of test samples, namely with varying levels of compressive strength, namely; 200 kg/m², 300 kg/m², 400 kg/m², 500 kg/m², and 600 kg/m². The test sample that has been printed with a dimension of 30 x 30 is then cut according to the standard SNI, JIS, and ASTM testing methods, namely 10 cm x 10 cm, then tested for the physical properties of the composite board.

3 Results and Discussion

The results shown in the early stages of testing the physical properties of the composite board from the test sample that had been printed based on the treatment characteristics of the test sample, namely as many as 5 test samples with different treatment characteristics, including:

Test sample with sample code A1, namely test sample with the treatment of 1.5 kg Particles: 1 kg Fiber: 0.5 kg PVAc compressive strength of 200 Kg, Test sample with sample code A2, namely test sample with the treatment of 2 kg Particles: 1.5 kg Fiber: 0.8 kg PVAc compressive strength of 300 Kg, Test sample with sample code A3, namely test sample with the treatment of 2.3 kg Particles: 1.8 kg Fiber: 1 kg of PVAc compressive strength of 400 Kg, Test sample with sample code A4, namely test sample with treatment of 2.5 kg Particles: 2 kg of fiber: 1 kg of PVAc compressive strength of 500 kg, test sample with sample code A5, namely the test sample treated with 2.8 kg of particles: 2.5 kg of fiber: 1.3 kg of PVAc of compressive strength of 600 kg. 5 test samples above with an average thickness of 2 cm, with a press time of 12 hours. thus, the results of testing the physical properties of the 5 samples shows in table 3.

Table 3. Sample Test Results

Sample	Density (gr/cm ³)	Water content (%)	Water Absorbency	Thickness Development (%)
A1	1.25	15.80	18.55	11.2
A2	0.93	14.25	17.30	9.80
A3	0.86	13.52	16.3	9.00
A4	0.66	13.25	15.2	8.25

A5	0.65	13.00	14.00	8.00
Control	0.4-0.9	5.0-20.0	12.00	5.00-25.00

The test results presented in Table 1 above show the level of density, water content, water absorption, and swelling in samples with higher compressive strength indicating smaller values. It is suspected that the higher the level of pressure, the higher the pores in the particles and fibers, and the tighter the adhesive, it can be assumed that water does not easily seep into the composite board. While the level of pressure is low, it is suspected that the pores of the fiber and adhesive particles are still tenuous, so this allows water to seep easily so that it easily fills the space in the composite. The following is a graphical display in Figure 3. Below shows the trend of increasing density levels, moisture content, water absorption, and expansion in each test sample.

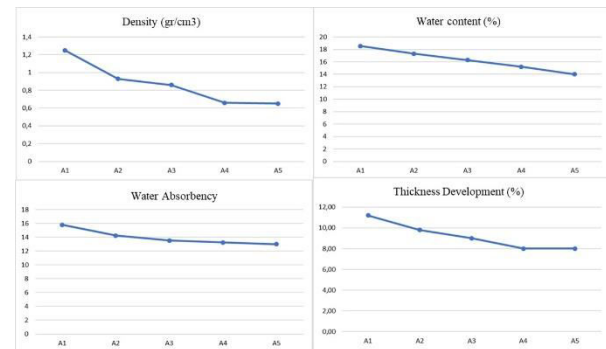


Fig. 1. The trend of pressure differences in the test samples

The trend graph in Figure 3 above shows the physical characteristics of the test sample of the composite board, sago leaf stalk. The nature of the adhesive that is not resistant to water is a factor that causes problems in composites. When the adhesive that is already solid on the composite is not resistant to water, the adhesive can be released, allowing water to easily seep into the composite board. Under these conditions, water can cause the formation of pores and reduce the structural quality of the composite board, so it is necessary to consider using an adhesive that is more resistant to water or special treatment on the composite board to make it more resistant to water penetration. That way, the quality and durability of composite boards can be increased.

4 Conclusion

From this study, it can be concluded that the results showed that the higher the level of pressure on the composite board sample, the lower the density, moisture content, water absorption, and swelling values. Such interpretations can be:

The level of pressure is high, the pores in the particles and fibers become smaller or completely

closed, and the adhesive between the particles and fibers becomes tighter. This results in low permeability of the composite board to water, in other words, water does not easily seep or enter into the composite board, because the pores are small or tightly closed which do not provide space for water to fill in the empty gaps in the composite.

The level of pressure is low, the pores in the fiber and adhesive particles are still tenuous or larger. This allows water to easily seep into the composite board, in other words, the permeability of the composite board to water is higher at low pressure levels, because the larger pores provide space for water to fill in the empty gaps in the composite.

PVAc adhesives are not resistant to water, this can cause the adhesive that is already solid on the composite to detach or degrade when exposed to water. As a result, composite board becomes more susceptible to water penetration and moisture absorption. The pores that form in the composite board can also increase the surface area exposed to water, which then allows water to seep in more easily.

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