Use Of Bamboo Powder Waste Into a Composite for Interior Lamp Shade Products

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ABSTRACT
This research aims to process sandalwood bamboo waste into composites which are alternative raw materials that have new material characteristics which are a form of material innovation for interior products. Apart from that, this is also a development of the use of bamboo waste in the form of sheet-shaped composites which have ductile, strong, flexible properties and which can be used to make a variety of environmentally friendly (ecogreen) interior products in the form of lampshades. Currently, there are many alternatives that use processed waste materials to make a product to reduce costs in terms of materials. Sandalwood bamboo powder waste is currently still not widely used, one of which is in Sayegan Hamlet which is a center for bamboo crafts in Sleman Regency, Yogyakarta. In this bamboo craft center area, bamboo powder waste is only piled up in the yard to then be burned, which can actually be processed and has added value. The method in this research uses experiments in the laboratory to produce a new material in the form of a composite between sandalwood powder (SB) bamboo waste and adhesive material (BP) from glycerin and seaweed agar. Composite composition with bamboo powder ranging from 10 gr, 20 gr, 30 gr, 40 gr and 50 gr with adhesive then mixed until homogeneous while heated to a temperature of 700 C for 5 minutes, after that it is poured into a mold and dried. The maximum tensile strength test results were 176.4 N/mm2 and the tear test was 258.8 gr. The sheet form composite has ductile, flexible and transparent properties, and is then applied to produce a variety of products for bamboo craftsmen by making lampshades which are expected to provide added value from bamboo powder waste.

Keywords: Bamboo, Composite, Lampshade

INTRODUCTION
Sandalwood bamboo plants are a type of grass plant that has very fast growth, in contrast to forest wood trees which are only ready to be cut down with good quality after they are 40-50 years old, so bamboo with excellent quality can be obtained only at the age of 3 - 5 years. Bamboo can be used as an engineering material in whole, strip, fiber and powder form (Nayak and Mishra, 2016). With the

development of industrial progress, especially small industries/craftsmen based on bamboo, one of the impacts is the waste problem that is generated. The type of bamboo waste generated is in the form of leftover casings, small pieces of bamboo, or powder form from the sawing process which is generally handled by burning (Arsad, E., 2015). The advantages of bamboo material when compared to wood include that bamboo can be harvested. in a shorter time, namely around 3 years, has high strength properties, has straight stems, has a small stem size, is easy to work with and is relatively cheap (Abdul Khalil et al., 2015).

UKM Rosse Bambu is a group of craftsmen engaged in the business of bamboo furniture and bamboo laminated materials, located in the bamboo craft center of Dusun Gentan RT 05 RW 19 Margoagung Seyegan, Sleman. Starting from the concerns of several young people in Margoagung village who saw the potential for this bamboo material to have great business opportunities but it had not been developed optimally and they also felt that the business groups that used to be numerous were starting to decrease due to the lack of product development. In this bamboo craft center, initially many people made keres, lincaks, chairs and several accessories from bamboo.

Due to the lack of development of the products produced, over time the products began to not sell and many of the craftsmen changed professions and left their bamboo businesses. The next anxiety felt by the many young people who are still unemployed is a concern for these young people because they have no income. Therefore, to overcome this problem, one way is to process sandalwood bamboo powder waste into a sheet-shaped composite so that it can become an environmentally friendly alternative raw material that can be used as an innovative material for making various products, including lampshade products. Processing by making composites as alternative raw materials can also provide added value from sandalwood bamboo powder waste. Image 1 shows one of the SMEs in a bamboo craft center and the waste pile of sandalwood bamboo powder which has only been stockpiled and has not been utilized to have added value as an alternative raw material in the form of composites.

Image 1 Location and Piles of Bamboo Powder Waste at the Bamboo Craft Center in Sleman Regency (Source: Author's documentation, 2024)

LITERATURE REVIEW

Sandalwood bamboo has the Latin word Bambusa glaucescens (Wild) Sieb ex Munro which is a type of bamboo that can only grow well in the highlands with a land height of between 1,336 meters above sea level – 2,500 meters above sea level and grows on the island of Java. Cendani bamboo can be used for pramika sticks, broom handles, craft materials, interior design, and fishing rods. Not only in Indonesia, bamboo crafts are also in great demand by buyers from outside Indonesia. The trade balance of the non-oil and gas processing industry in July 2023 recorded a surplus of US$ 801.64 million, one of which was from bamboo craft products (kemenperin.go.id., 2024).

Bamboo plants are spread throughout the world, where 80% of the population grows abundantly in South and Southeast Asia. Meanwhile, around 50% of all bamboo varieties grow well in Indonesia (Febriana, 2019). Bamboo is known by the public to have properties that are good for use, including its stems being strong, resilient, straight, even, hard, easy to split, easy to shape and easy to work with and light so it is easy to transport. Apart from the high multi-functionality of bamboo, there are several weaknesses of bamboo, including: workmanship is not easy because it breaks or cracks easily, it is easily attacked by wood-destroying insects so it is not durable (not durable), variations in dimensions and non-uniformity in the length of the segments (Wulandari, 2018).

From the research results, the composite with the addition of 15% bamboo powder had a density value of 0.1093 gr/cm3 and a flexural strength of 28.20 MPa. (Siti K, 2016). Besides that, as the composition of bamboo powder increases, the wear rate of the brake lining sample becomes lower (the more resistant it is to wear) and the higher the hardness rate of the brake lining sample. So variations in the composition of bamboo powder greatly influence the wear rate and hardness rate of the brake lining samples. (Prisma F.W, 2012).

In the use of bamboo into composites, it is an alternative effort to produce alternative raw materials to replace wood. There are differences between bamboo and wood biocomposites, especially variations in micro and macro characteristics, physical and chemical composition and mechanical properties (Chaowana and Barbu, 2017). By knowing that the quality and durability of materials are comparable between similar materials, biocomposites with lower costs will bring a new evolution in terms of interior production and the world of manufacturing.

It is felt that there is still a shortage of wood raw materials to meet industrial needs in Indonesia, both from timber forests and plantation forests, so the government is currently trying to find various alternative materials to replace wood. As the population increases in Indonesia, the speed of wood utilization is not balanced with the speed of growth of existing wood (Saputro, 2017). One material that can replace wood is bamboo, where bamboo is classified as a non-timber forest product which can be applied for various types of purposes, for example bamboo is used in the furniture and construction industry which is expected to be an alternative

solution to the problem of increasingly scarce availability of wood (Arsad, 2015). In creative design activities, precision and careful planning are very necessary so that new products with better quality can be obtained.

For this reason, in product design, most of the designs are designed by considering several factors, including strength and aesthetic value, based on the results of in-depth studies on a material (Siti Suhaily, 2017).

Sleman Regency, which is in the DIY Province, is an area with great potential for bamboo production. Bamboo is a sustainable natural fiber, this plant can grow very quickly, and has excellent mechanical performance (Sanal, 2016).

The bamboo forest in Sleman Regency covers an area of 525 ha, equivalent to 125,000 groves, with production reaching 800,000 – 850,000 culms each year. The types of bamboo craft products in Sleman Regency consist of bamboo furniture, gedek and woven braids, household furniture from bamboo, and souvenirs from bamboo (Mulandari & Budiani, 2019). Sleman Regency is an indication of an area with very abundant bamboo potential with the presence of at least 10 types of bamboo with the most abundant type of bamboo being apus bamboo followed by sandalwood bamboo

METHODOLOGY

Preparation of materials and tools

The materials used in research on making composites were sandalwood bamboo powder (SB) and glycerin adhesive (BP) and seaweed agar. Bamboo powder is taken from bamboo craftsmen in the bamboo craft center in Sleman Regency, Yogyakarta. Bamboo powder waste is dried and cleaned from dirt in the form of existing bamboo strips. The adhesive consists of glycerin and seaweed agar mixed with a composition of 25% glycerin and 75% agar, which is then placed in a pan containing 300g of water.

Meanwhile, the equipment used to make composites uses a stove, stove, pan and stirrer and an aluminum mold measuring 25cm x 25cm x 3cm. For tensile testing, a Mesdan Lab.s.p.s Model Tenso 300 Type 168 E machine was used, while the tear test was used with an Elmendorf 2000 Tear Tester type machine.

To understand the qualities and shortcomings of a particular material during the product design process based on the material, it is important to thoroughly understand the material. This may be achieved through a process of “tinkering with the material”, a kind of exploratory process of creation and evaluation, from the first encounter with the material to the perfect final product at the end of the process (Karana, 2015).

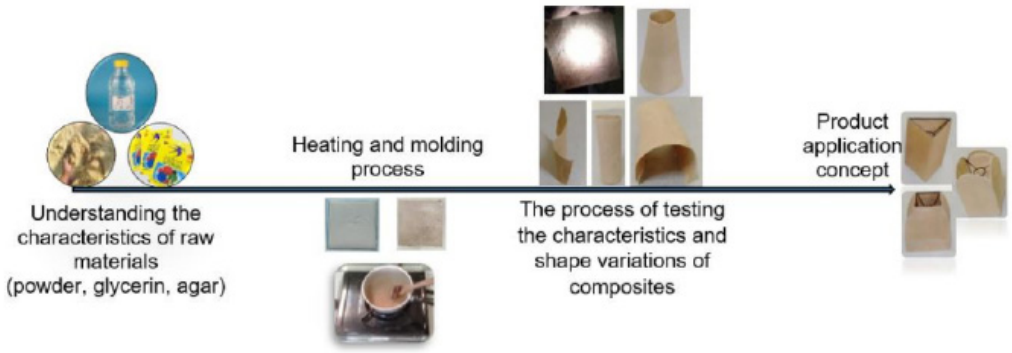

Image 2 Research Flow Diagram.

Composite Manufacturing

In this research, variations in the composition of bamboo powder (SB) of 10 gr, 20 gr, 30 gr, 40 gr and 50 gr were used from the mass fraction of the composite. Meanwhile, the adhesive composition (BP) consists of glycerin and agar with a ratio of 25:75 matrix mass fraction. The composition of each specimen is shown in Table 1 as follows:

Table 1 Composition of Bamboo Powder (SB) and Adhesive Material (BP) (Source: Author's Documentation, 2024)

Speimen Code	Bamboo Powder Composition (%)	Adhesive Composition (%)
10SB-BP	10	90
20SB-BP	20	80
30BP-BP	30	70
40SB-BP	40	60
50SB-BP	50	50

Heating Process, Mold Shape, Mold Result

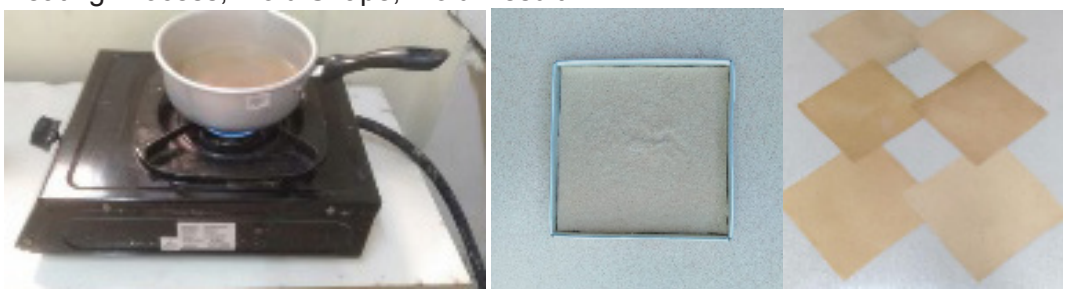

Image 3 Composite Product Process.

In making the composite, the adhesive material (BP) and bamboo powder (BP) are first mixed with water in a pan heated on the stove at 700 C while stirring until homogeneous for 5 minutes. After that, it is poured into the mold and dried with the help of a dryer. After drying, the sheet-formed composite was made into a tensile test specimen measuring 10 cm and 7.5 cm wide. and a tear test measuring 10 cm x 7.5 cm. After the mechanical properties testing process continues with the composite application for making lampshade products.

RESULT & DISCUSSION

Mechanical Properties Analysis

Mechanical properties are carried out by tensile strength testing and tear testing. This is done in accordance with the desired characteristics in the application of composites, namely for making interior products, namely lampshades. Table 2 shows the average tensile test results from testing each specimen.

Table 2 Composite Tensile Strength Test Results. (Source: Author Documentation, 20024)

No	Specimen Code	Tensile strength (N/mm^2)	Average value (N/mm^2)
1	10SB-BP	146.3 147.2 146.6	146.7
2	20SB-BP	156.6 155.8 156.7	156.3
3	30SB-BP	175.6 176.7 176.9	176.4
4	40SB-BP	158.5 157.9 185.5	158.3
5	50SB-BP	149.3 149.9 149.3	149.5

The results of the composite tensile strength test are shown in Figure 4. In this graph, the 10SB-BP composite has the lowest tensile strength value of 146.7 N/mm^2. By gradually adding 10 grams of bamboo powder to 20SB-BP and 30SB-BP, the tensile strength value is obtained. to 156.3 kg/mm^2 and 176.4 N/mm^2, at this stage the tensile strength of the composite experiences an increase. Furthermore, with the addition of bamboo powder, it turns out that the tensile strength value has decreased. From the results of composite observations, this is because the composites starting from 40SB-BP powder experienced a compositional imbalance with the adhesive material (BP), so that the adhesion of the adhesive material

affected the tensile strength of the composite. Thus, in this study the composite that has the maximum tensile strength is 30SB-BP with a maximum tensile strength value of 176.4 N/mm^2.

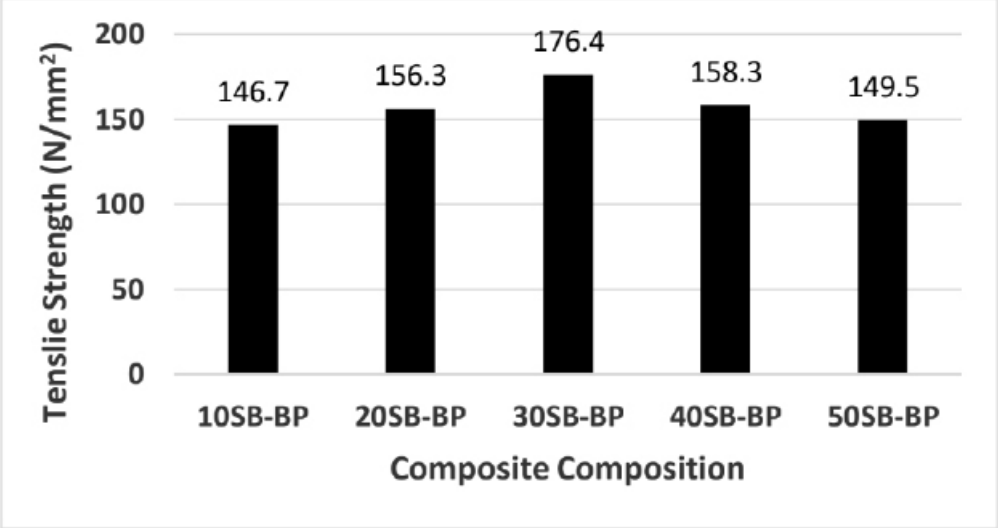

Image 4 Tensile Strength of Bamboo Powder Composite.

In the mechanical properties analysis, the tear test results aim to determine the ability of the composite when receiving tear loads during the process of making kapu kapu products. From the test results, tear strength data for the SB-BP composite was obtained which is shown in Table 3.

Table 3 Test results for SB-BP composite tear strength (Source: Author's Documentation, 20024)

No	Specimen Code	Tear strength (N/mm^2)	Average value (N/mm^2)
1	10SB-BP	228,7 228,5 228,9	228.7
2	20SB-BP	235,7 236,1 235,6	235.3
3	30SB-BP	258,4 259,1 258,9	258.8
4	40SB-BP	238,4 238,7 237,8	238.3
5	50SB-BP	249.9 248,9 349,7	249.5

Based on Table 3, it is known that the composite with 10% bamboo powder ((10SB-BP) has the lowest tear strength, namely 228.7 gr. The small mass fraction of bamboo powder causes the distance between the powders to be large, so that the contact area between the powder and the matrix is low. (L.Wang, 2015). Furthermore, by adding bamboo powder to the 30SB-BP composite, it reached a maximum tear strength value of 258.8 gr. At this point, the composition between the bamboo powder and the adhesive matrix (BP) reached an equilibrium level This is shown by the addition of bamboo powder to the 40SB-BP composite and 50SB-BP composite. The tear strength has decreased. Thus, it can be concluded that the maximum tear strength of the 30SB-BP composite is shown in Image 5 below.

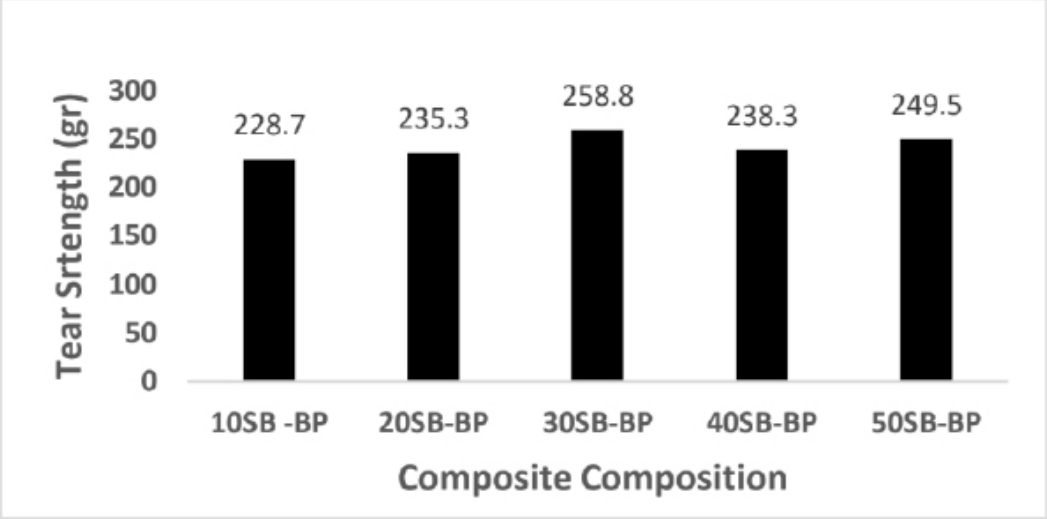

Image 5 Tear Strength of Bamboo Composite (SB-BP).
(Source: Author Documentation, 20024)

Image 5 above shows the ability of the composite to accept tear loads as shown by the tear strength value that occurs in the 30SB-BP composite, namely 258.8 gr. This occurs because in this composition the bond between the matrix and the reinforcement (reinforcement) occurs in balance and after that The addition of adhesive powder (BP) causes the adhesive power to weaken or decrease.

Application in Products

By obtaining a composite composition between bamboo powder (SB) and adhesive material (BP) which has a maximum strength value of 30SB-BP, it is then applied to interior products in the form of lampshades. The resulting composite has strong and flexible properties, the flexible properties are influenced by the adhesive materials glycerin and seaweed agar. Flexible properties are demonstrated by composites that can be formed into curves or tubes as shown in Image 5.

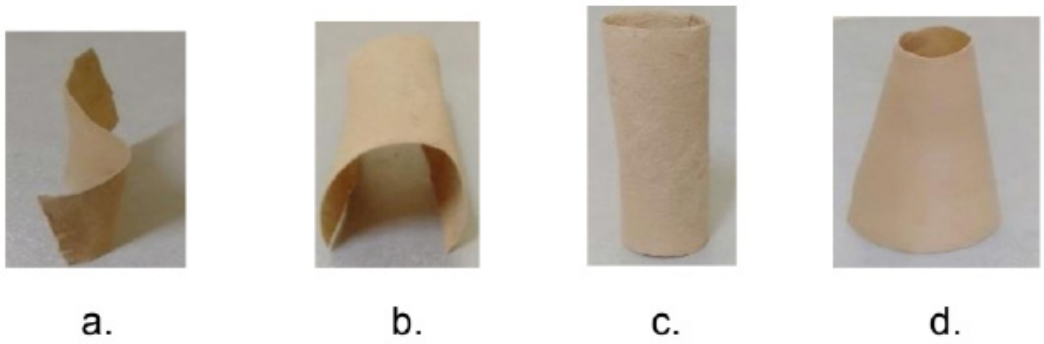

Image 6 Composites in Several Forms of Curvature. (Source: Author Documentation, 2024)

In Image 6, The composite research results were then applied to make a lampshade, with several shapes then tested and producing a lampshade with light transparency properties on the lampshade that was attractive and suitable for lighting but not dazzling.

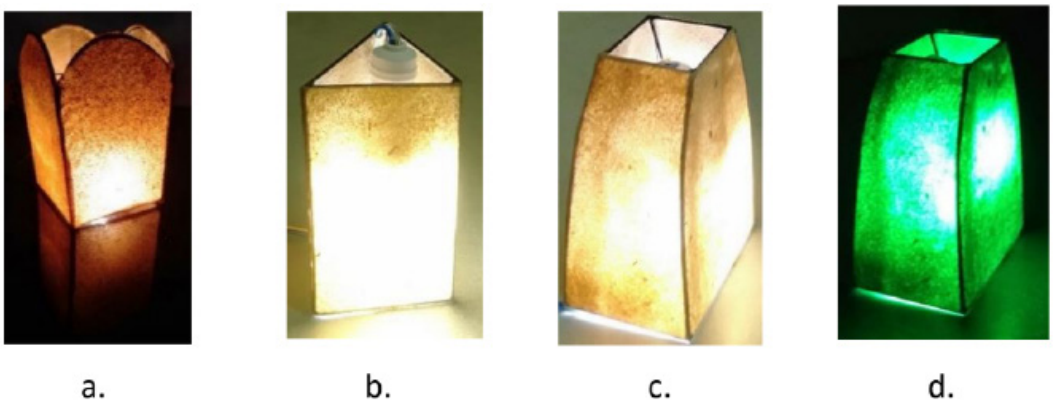

Image 7 Application of Composites in Several Forms of Lampshades.
(Source: Author's Documentation, 2024)

CONCLUSION

Based on the results of research on sandalwood bamboo powder waste composites in the composition 30SB-BP, it turns out that it has the best composite composition balance based on the maximum tensile strength value of 176.4 N/mm2 and the maximum tear strength of 258.8 gr. With this strength value, the resulting composite can be used as an alternative base material. Apart from that, from the observations the resulting composite has ductile and flexible properties so it can be used to make interior products in the form of lampshades.

For bamboo craftsmen, the use of sandalwood bamboo waste which has not been used optimally can be processed to bring added value to the craftsmen and reduce the environmental impact. This sandalwood bamboo powder composite can be developed in research so that it can become an alternative raw material for making construction products.

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