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Physical Properties of Polymer Composit Reinforced by Salak Bark Fiber (*Salacca zalacca*) and Nipah Bark Fiber (*Nypa frutican*)

Nurfajriani[1*], Muhammad Yusuf[1], Herlinawati[1], Mutia Ardila[2], M. Weryninda[1]

[1] Department of Chemistry, Faculty of Mathematics and Science, Universitas Negeri Medan, Medan, Indonesia
[2] Department of Chemistry Education Faculty of Mathematics and Science, Universitas Negeri Medan, Medan, Indonesia

*Corresponding author: nurfajriani@unimed.ac.id

ABSTRACT

Fiber composite is a material that has been widely used such as in vehicles, buildings and in industry. The use of natural fiber materials is prioritized because the costs incurred are relatively cheaper and also more environmentally friendly. This study aims to test the physical properties of composite reinforced by salak bark fibers and nipah bark fibers. The fibers are soaked using a solution of Sodium Hydroxide for 2 hours. The variation of the volume fraction used is 5% : 5% ; 5% : 10% ; 5% : 15 % ; 5% : 20%. The physical properties test carried out is a density and moisture content test. Based on the results of the study, the highest density value was 0.927 %. Meanwhile, the moisture content test value showed the highest moisture content value of 1.90%.

Keywords: *composit, natural fiber, physical properties*

1. INTRODUCTION

Currently, technological developments in the field of materials continue to develop. Fiber composite is a material that has been widely used such as in vehicles, buildings and in industry. The use of natural fiber materials is prioritized because the costs incurred are relatively cheaper and also more environmentally friendly.[1] At this time, composites with synthetic fiber reinforcing materials have been used in various aspects of life, both in terms of use, and technology. However, the use of synthetic fibers as composite reinforcers has a negative impact on the environment as the waste is not biodegradable and can disrupt for generations.[2] Therefore, natural fibers are good for use in the manufacture of composites.

Composites are composed of 2 types, namely synthetic composites and natural composites or

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natural fibers. Natural fiber composites have advantages, namely strong, lightweight, economical, heat-resistant, environmentally friendly and so on. The fiber component used for composite materials is cellulose, where cellulose gives strength to the fibers. Cellulose with the chemical formula $(C_6H_{10}O_5)n$ is an organic compound that is insoluble in water and is a component of vegetable fiber. Composites are composed of a matrix that functions as an adhesive or binder as well as a protective filler from external damage and a filler that functions as a reinforcer.[3,4]

In the manufacture of composites, the compound used as a filler is cellulose. This is because cellulose has excellent mechanical properties so that it can be used as a reinforcement in composites.[5] Cellulose fibers can react with hydrophilic resins and form a composite of very compact three-dimensional structures. Cellulose fibers that are strong and have good thermal properties will produce good composites because they are not affected by a wide range of factors such as temperature and humidity.[6]

In natural fiber-reinforced polymer composites, the interface properties of the matrix and fibers need to be considered. This has to do with the compatibility between the fibers and the matrix and the hydrophilic properties of the fibers.[7] The matrix used in this study is polyester resin. Unsaturated polyester is a thermoset that is widely used as a composite matrix with reinforcement from cellulose natural fibers. This resin is widely used in composite applications in the industrial world.[8,9,10] Previous research in the manufacture of composites by combining nipah husk flour with wheat flour produced the highest moisture content of 15.68%. Meanwhile, the manufacture of composites using salak bark as a filler showed the highest density value of 0.953 g/cm^3.

Based on the above background, research will be carried out by varying bark salak fibers and bark nipah fibers in composite manufacturing. Salak bark fiber and nipah bark fiber are chemically treated using a solution of Sodium Hydroxide. The physical properties tests carried out include density tests and composite moisture content tests.

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

The tools used in this study are 80 mesh sieve, digital scale, composite mold, plastic beaker, grinder, spatula and cutter. The materials used are bark of salak, bark of nipah, polyester resin, MEKPO catalyst, 5% sodium hydroxide, aluminum foil, and aquaculture.

2.2. Research Procedure

2.2.1 Sample Preparation

Sample preparation was carried out by soaking bark salak and bark nipah fibers in a 5% Sodium Hydroxide solution for 2 hours. Next, the fibers are rinsed using aquatics. The fibers are then dried in the oven at 60^0C for 24 hours until the fibers are dry. The sample is crushed using a grinder then sifted using an 80 mesh sieve.

2.2.2 Composite manufacturing process

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The composite molding process is carried out by weighing the fibers and resins first according to the calculation of the volume fraction. The variation in the combination of bark salak fiber and bark of nipah fiber used is 5%:5%; 5%:10% ; 5%:15% and 5%:20%. The composite mold is coated with aluminum foil then waxed on each side of the mold. The mixture of resin, catalyst is stirred, then bark salak fibers and bark of nipah fibers are added to the plastic beaker and then stirred using a spatula until homogeneous. The dough is poured into a mold then put into a hotpress. After cooling, the composite specimen is removed from the mold using a cutter.

2.2.3 Composite testing

a. Density

The density value is obtained based on the composite mass per mold volume. This density test was carried out with a sample measuring 1 x 1 x 20 cm. Composite specimens are weighed first and then measured in volume.

b. Moisture content

The moisture content test value was obtained based on the mass before and after the oven. Composite specimens used for density testing. The dry mass of the specimen was weighed and then the specimen was baked at 80 ^{0}C for 2 hours. The specimen is put into a desicator for 15 minutes then weighed.

3. RESULTS AND DISCUSSION

3.1. Density test Results

The purpose of this density test is to determine the lightness of a composite. Density is a measurement to determine the density of a material. This density value is obtained from the weight of the mass divided by the composite volume. This density value is also influenced by the composite mass, the larger the mass, the greater the density value. Based on the SNI 03-2105-2006 standard, the density of the specimen is 0.4-0.9 g/cm3. The results of the density test can be seen in the table below.

Table 1. Density test results

Fiber composition (%)	Volume (cm^3)	Mass (gr)	Density (g/cm^3)
5 : 5	20	15,287	0,764
5 : 10	20	16,756	0,837
5 : 15	20	17,251	0,862
5 : 20	20	18,541	0,927

From table 1. It shows that as the volume fraction of fiber composition increases, the density value increases. The density value in the composite specimen is influenced by the presence of void in the specimen. When the matrix with fibers is not able to bond properly, it will result in an air

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cavity. The higher the density value, the more cavities in the composite.

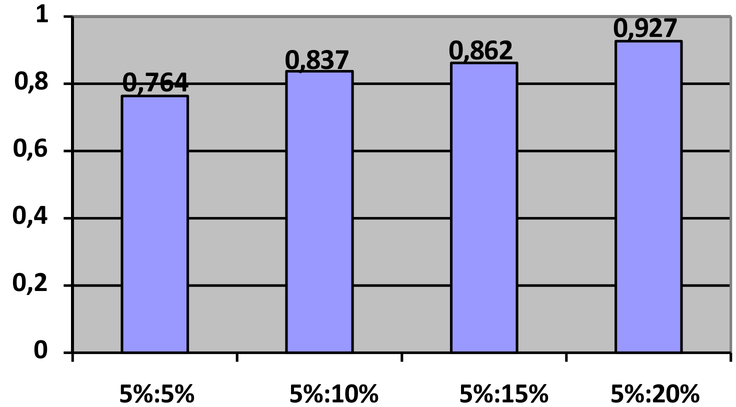

Figure 1. Graph of the effect of volume fractions on composite density

Based on figure 1. The density values in the four variations above show an increase along with the increase in the variation of the fiber fraction used. The highest density value is shown in the variation of 5% : 20% which is 0.927%. In accordance with the SNI Standard, this density value has crossed the limit. The lowest density value is shown in the variation of 5% : 5% which is 0.764%. Based on the data from the density test results, three variations met the standard and one variation had crossed the standard limit for composite specimens.

3.2. Moisture content test Results

The purpose of the moisture content test is to find out what percentage of moisture content before and after ovening. This moisture content value is obtained from the mass before and after ovening. Based on the SNI 03-2105-2006 standard, the percentage of moisture content is < 14%. The results of the moisture content test can be seen in the following table.

Table 2. Moisture content test results

Fiber composition (%)	Mass sampel (g)		Moisture content (%)
	Before oven (m_1)	After oven (m_2)	
5 : 5	15,287	15,090	1,30
5 : 10	16,756	16,554	1,22
5 : 15	17,251	17,012	1,38
5 : 20	18,541	18,187	1,90

Based on table 2. Showing an increase in moisture content values along with increasing volume fractions. This increase in moisture content is also influenced by the raw materials used. In addition, the water content contained in the composite is affected during the composite manufacturing process. The moisture content value of the composite has an effect on the quality of

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the composite. Where the low moisture content has a composite with high quality. On the other hand, composites with high moisture content values will cause the composite to be easily damaged.

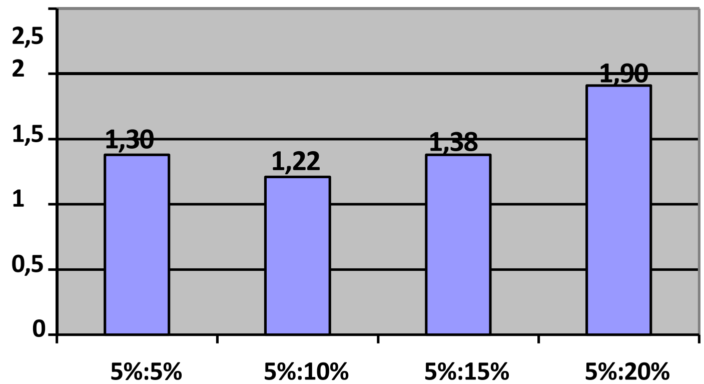

Figure 2. Graph of the effect of volume fraction on composite moisture content

Based on figure 2. The moisture content value decreased in the second variation, where the moisture content value of the third and fourth variations was increasing. The lowest moisture content value is shown in the variation of 5%: 10%, which is 1.22%. Then the highest moisture content value is shown the highest variation of 5%: 20% by 1.90%. Nonetheless, all specimens in various composite variations meet SNI standards. Based on these results, the value of composite moisture content is influenced by various things, both the raw materials used and the process of making specimens.

4. CONCLUSION

The conclusion of this study is that the results of the composite density test have the highest value at the variation of 5%: 20%, which is 0.927% and the lowest value at the variation of 5%: 5%, which is 0.764%. The larger the mass of the specimen, the higher the density value. The density values of three variations meet the standard and one variation exceeds the standard limit. The results of the composite moisture content test had the highest value in the variation of 5%: 20%, which was 1.90% and the lowest value in the variation of 5%: 10%, which was 1.22%. The higher the moisture content value, the more easily the composite will be damaged. The moisture content value of the four variations meets the SNI standard.

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