COMPOSITE MATRIX *POLYESTER* REINFORCE FIBRESKIN GELAM; PREPARATION AND MECHANICAL PROPERTIES

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ABSTRACT

Gelam (melaleuca leucandendra) is one plant that is widely available in South Sumatra potential into cellulose extraction. His plant is widely used for building materials and wood products processed the rest of the powder timber furniture industry. While, the skin of this plant is not used for anything. In fact, from the structure of the skin that have fiber, skin of gelam has the potential to be a valuable product, one of them with a matter in the form of composite reinforcement. While today's technology demands urgent environmental friendly technology product makers, especially friendly to the environment. The analysis conducted in this study utilizes softwood bark fiber serves as reinforcement to resin volume fraction ratio : Resin 100% : *Filler* 0%(A), Resin 90% : *Filler* 10% (B) Resin 80% : *Filler* 20%(C), Resin 70% : *Filler* 30%(D), Resin 60% : *Fille*r 40% (E). Observed characteristics are kekutan composite tensile and impact strength. On average the highest tensile stress is the value obtained from the variation of the volume fraction of the specimen D (70% resin: 30% fiber) that is equal to 17.96 N/mm2, while the average value obtained from the lowest voltage variation of the volume fraction of the specimen B (90 % resin: 10% fiber) that is equal to 12:35 N/mm2. The average value of tensile strain obtained specimens A, B, C, D and E are the same, namely 0.68%. High MOE happens to specimens B, C and E, it indicates that the greater the value of the modulus of elasticity of the material is more difficult to increase the length, in this case the smallest specimen D modulus of elasticity. The average value of the energy required to break the specimen is equal to the highest Joule 34.728, obtained from the variation of the volume fraction of specimen D (70% resin: 30% fiber).

Keywords: *Fiberglass, resin, softwood, tensile test, impact test.*

1. INTRODUCTION

Developments in science and technology is increasingly making progress. The industrialized world is one area that showed rapid growth. It is inseparable from the demands of the market that requires new and creative innovation in rejuvenating products in a more efficient and more environmentally friendly. One way in developing products that are now commonly used is the transfer of the material composition of metal products into non-metallic materials. Polymer materials are developed to replace metal that is widely used before the development of composite materials. Seeing this author is trying to develop a composite material by utilizing fiber softwood bark (melaleuca leucandendra) as filler or reinforcement of the composite, due to its use softwood skin has never been used or may be used. Therefore, the authors took the initiative to take advantage of this softwood bark fibers for composite reinforcement material of environmentally friendly technologies.

2. REVIEW OF LITERATURE

2.1 Definition of Composite

Composite material is a material composed of a mixture or combination of two or more major elements that are different in shape and macro or material composition that essentially can not be separated. The advantages of composite materials compared to metals is resistance to corrosion or environmental influences are free and for certain types of composites have high strength and stiffness better, therefore, ongoing research is directly proportional to the development of the particular composite material technology. The development not only of the composites composite synthetic but also natural renewable composites, thereby reducing environmental pollution (Schwartz, 1984).

2.2 Classification of Composites

Composite materials are usually classified by the type of reinforcement such as polymer matrix composites, cement and metal matrix composites. Polymer matrix composites are most frequently produced composite commercial where the resin is used as a reinforcing material matriknya different. Polymers (resins) are classified into two types of thermoplastic (polyethylene (PE), polypropylene (PP), polyether ether ketone (PEEK), clorida polyvinyl (PVC), polystyrene (PS), polyolefin, etc.) and thermoset (epoxy, polyester, and phenol -formaldehyde resins, etc.) and the strengthening matrix is usually different types such as natural fibers (fibers of plants, animals, minerals) and man-made for different applications.

2.2.1 Fiber Composites

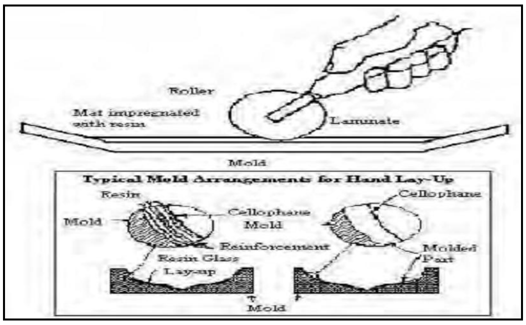
The main element is a composite fiber which has many advantages, therefore the fiber composite material most widely used. Fiber composite material made up of fibers that are bound by a matrix of interconnected. Fiber composite material consists of two kinds, namely the long fibers (*continuous fiber*) and fiber (*short fiber and whisker*). In this report drawn fiber composite materials (*fiber composite*). The use of fiber composite materials are very efficient in receiving loads and style. Because the fiber composite material is very strong and rigid when loaded fiber direction, otherwise very weak when loaded in a direction perpendicular to the fiber.

2.3 *Polyester*

These resins are thermosetting resins included in the class, in most cases this is called polyester alone. Because a liquid resin with a relatively low viscosity, hardens at room temperature without the use of a catalyst to produce gas when setting thermosetting like many others, it does not need to be pressure for printing. Based on these characteristics, the material developed extensively by using glass fibers as reinforcement.

2.5 *Hand Lay-Up* Methods

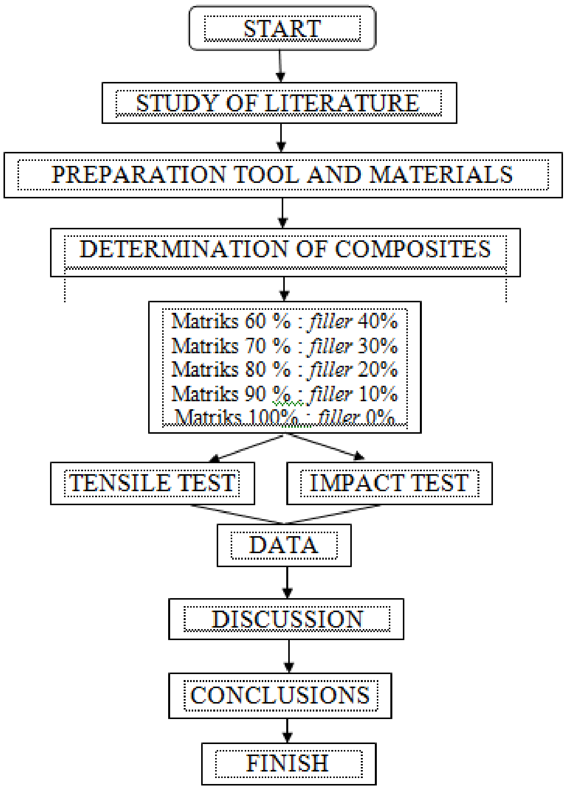
Hand lay-up method, also called the way the lay-up is a method of making the composite resin into the mold to fill in by hand into fibers in a container. In this method, the fiber can be arranged, woven, or tied. Usually to flatten the surface of the resin used roller or brush. Smoothing or suppression is done so that the resin and fiber completely fused.



Picture 1: *Hand Lay-Up* Methods

3. RESEARCH METHODOLOGY

This research was conducted with an experimental method in the laboratory is supported by the literature that support. The research methodology can be seen in the schematic below:



Picture 2: Scheme Research Methods

3.2.2 Collecting Kulit Kayu Gelam

Collection of softwood bark of softwood seller for its pelt is then processed, as for the steps as follows:
Filtration
Comparison HEXANES solution 10 ml: 1500 ml: 1 kg of softwood bark. Soaked for 2 hours after it was rinsed with ar clean and dry, then do the process of soaking in a solution of concentrated H2SO4 to get the required ratio of 1.25% 10 ml H2SO4: water 766 ml. Heated to 200C kemudiaan softwood bark inserted and left for 2 hours after rinsed and then boiled for 1 h into a solution of NaOH which had been simmering at a ratio of 32.5 g NaOH: 1 liter of water. Having clean skin is dried softwood open until dry. In the process of cutting, softwood bark-size cut to size to mix evenly.

3.3.3 Analysis and Data Processing

After all testing is complete, the existing data compiled and then processed to analyze the tensile strength and impact strength .. Furthermore, the data calculation results compiled in table form is then displayed in graphical form.

4. ANALYSIS AND DISCUSSION

Making matrix composite materials with fiber reinforced polyester resin softwood bark is done by using hand lay-up methods. Specimens have been prepared then testing, such as tensile test and impact test. Tests performed on each - each different sample variation of the volume fraction, is:
(100% resin)
(90% resin : 10% gelam fiber)
(80% resin : 20% gelam fiber)
(70% resin : 30% gelam fiber)
(60% resin : 40% gelam fiber)

4.1 Tensile Test Result

4.1.1 Stress

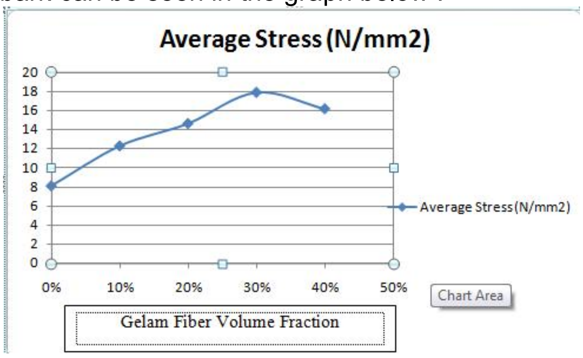
The percentage of fibers in the composite is too much can lead to more brittle composite, is caused by imperfect bonding between resin and fiber softwood bark and also the amount of porosity that occurs.

Average tensile strength for all the different types of specimens, suggesting that the influence of the volume fraction of softwood bark fibers are used.
Specimen D with a 30% fraction of softwood bark fiber has a tensile strength that is 17.96 N/mm2 and the largest specimen B with a 10% fraction of softwood fiber has a tensile strength value most low at 12.35 N/mm2.

Table 1. Average value Tensile Stress

Gelam Fiber Volume Fraction	Stress (σ) (N/mm²)	Average Stress (σ) (N/mm²)
0%	8,08	8,16
	7,84	
	8,57	
10%	12,50	12,35
	12,05	
	12,50	
20%	14,47	14,7
	14,94	
	14,70	
30%	17,64	17,96
	18,37	
	17,88	
40%	15,92	16,24
	16,41	
	16,41	

The relationship between the average stress - average variation in the ratio of fiber volume fraction of softwood bark can be seen in the graph below :



Picture 3 : Graph showing the relationship between stress (□) with a ratio of fiber volume fraction variation of softwood bark.

Above result can be compare with the results of tensile strength and modulus of elasticity of Composite bamboo fibers and glass fibers that have been tested. (Porwanto, 2011).

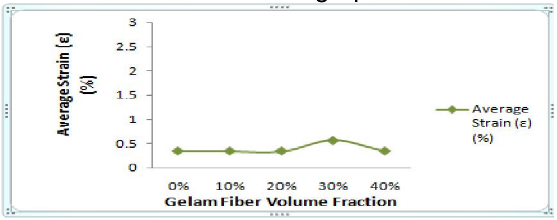
For both types of composite elastic modulus values obtained also varied up and down. The accuracy elongation-fiber reinforcement polymer composites obtained after tensile test were also influential on the value of the modulus of elasticity of the composite. The greater the elongation value, the greater the composite modulus value elasisitasnya. While the results obtained yaiu at 2.5% volume fraction of reinforcement obtained polymer-filler composite bamboo fiber with the highest elastic modulus of 1326.9 MPa and modulus of elasticity of composite reinforcement volume fraction low in 12.5% of 221.502 MPa. For this type of composite polymer-glass fiber reinforcement fibers obtained results at 10% volume fraction of reinforcement obtained composites with high modulus of elasticity is 916.220 MPa. While the lowest composite elastic modulus at 12.5% volume fraction of reinforcement of 267.313 MPa. From the results of both types of composite elastic modulus above should directly proportional to the increase in its volume fraction of reinforcement, voids are also well be one contributing factor. (Porwanto, 2011).

4.1.2 Strain

Table 2. Average value strain (ε) Tensile

Gelam Fiber Volume Fraction	Strain (ε) (%)	Average Strain (ε) (%)
0%	0,68	0,68
	0,68	
	0,68	
10%	0,68	0,68
	0,68	
	0,68	
20%	0,68	0,68
	0,68	
	0,68	
30%	0,68	0,68
	0,68	
	0,68	
40%	0,68	0,68
	0,68	
	0,68	

Strain the relationship between the average - average in the ratio variation of fiber volume fraction of softwood bark can be seen in the graph below:



Picture 4 : Graph showing the relationship between strain (ε) with a ratio of gelam fiber volume fraction.

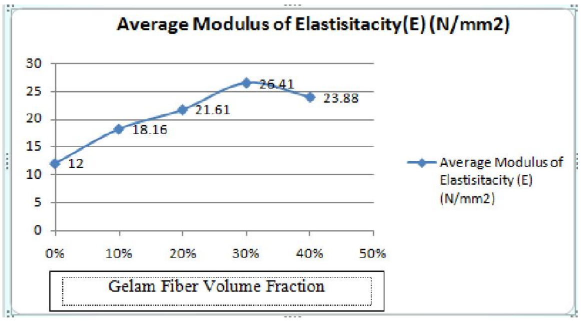
The length or strain from each of the tensile test specimen was relatively small at all indicates that the volume fraction of the composite is characterized by brittles.

4.3 Modulus of elasticity

Table 3. Average value Modulus of Elsticity (E)

Gelam Fiber Volume Fraction	Average Modulus of Elastisitacity (E) (N/mm²)
0 %	12
10 %	18,16
20 %	21,61
30 %	26,41
40 %	23,88

The relationship between the modulus of elasticity (E) the average - average in the ratio variation of fiber volume fraction in the composite softwood bark can be seen in the graph below.



Picture 5 : Graph showing the relationship between the modulus of elasticity (E) in the ratio of gelam fiber volume fraction.

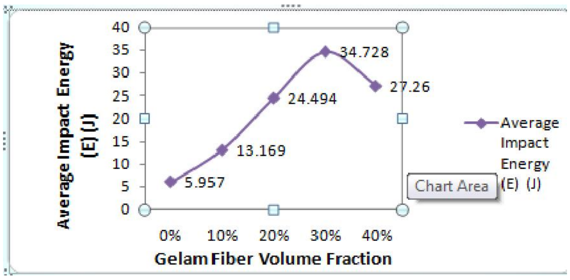
Average value of the modulus of elasticity - the highest average obtained from the variation of the volume fraction E (60% resin: 40% fiber) that is equal to 46.4 N/mm2, while the average value of modulus of elasticity - the lowest average obtained from the variation of the volume fraction of specimen D (70% resin : 30% fiber) that is equal to 31.5 N/mm2.

4.3.1 Impact Test Result

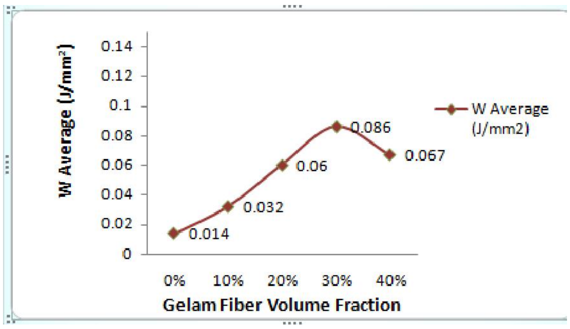
Table 3. Average Value Energy of Impact

Gelam Fiber Volume Fraction	E_1 (kg/m)	E_2 (kg/m)	E (E_1-E_2) (Joule)	W (E/A_0) (J/mm²)	E Average (J)	W Average (J/mm²)
	16,666	15,400	12,405	0,031		
0%	16,666	16,383	12,733	0,006	5,957	0,014
	16,666	16,383	12,733	0,006		
	16,666	15,228	14,090	0,035		
10%	16,666	15,510	11,327	0,028	13,169	0,032
	16,666	15,228	14,090	0,035		
	16,666	13,507	30,955	0,077		
20%	16,666	14,637	19,882	0,049	24,494	0,060
	16,666	14,355	22,645	0,056		
	16,666	13,225	33,718	0,084		
30%	16,666	12,634	39,513	0,098	34,728	0,086
	16,666	13,507	30,995	0,077		
	16,666	14,072	25,418	0,063		
40%	16,666	13,790	28,181	0,070	27,260	0,067
	16,666	13,790	28,181	0,070		

The relationship between the average energy value - average required to break the specimen (E), and the impact energy per unit area (W) average - the average variation of the volume fraction of the composite can be seen in the following graph:



Picture 6 : Graph showing the relationship between impact energy (E) with a ratio of gelam fiber volume fraction.



Picture 7 : Graph showing the relationship between the value of impact energy per unit area (W) with a ratio of gelam fiber volume fraction.

Impact of energy prices and the impact on average most large specimens obtained by D which is 30% fiber volume fraction of softwood bark with a value of 34.728 Joule mpact energy prices and the impact of 0.086 J/mm2, while the smallest is the specimen B is 10% fiber softwood bark with impact energy of 13.169 A and the price impact of 0,032 J/mm2. This indicates that the specimen D with fiber volume fraction of 30% softwood bark has a value of impact energy prices and the impact of the most optimum.

The optimum condition was obtained by specimen D (70% resin: 30% softwood bark fiber), which is :
Tensile stress value by an average of 17.96 N/mm2, tensile strain value by an average of 0.57%, amounting to 31.5 N/mm2 Modulus of elasticity, impact energy and impact the price of the average - average of 34.728 J and 0.086 J / mm2.

4. CONCLUSIONS

The use of catalysts must be considered, because it can affect the drying time and the mechanical properties of the composite. The more the composite catalyst will quickly dry out, but make the material more brittle. At the time of the manufacture of composites by the method of Hand Lay-ups have to be really careful and cautious, the air trapped in the porosity of the composite can be a cause of mechanical ability composites decreased. It is advisable to conduct tests to determine how far the SEM porosity occurs.

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