The Influence of Length of the Stem of Klutuk Banana (Musa Balbisiana) Toward Tensile Strength: A Review of the Mechanical Properties

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Abstract - This study is testing the effects of fibre length on tensile strength and strain on the stem of klutuk banana fibre specimen with length of fiber are variation of 10 cm, 7 cm, 5 cm and 3 cm. The results showed that composite fibres stem of banana with tensile strenght test result is specimen of 10 cm (25.38 N/mm^2), specimen of 7 cm (14,47 N/mm^2), specimen of 3 cm (17,27 N/mm^2) and specimen of 5 cm (12,08 N/mm^2). The result is strain specimen and extension of 10 cm (20,14), specimen of 7 cm (9.95), specimen of 5 cm (5,49) and specimen of 3 cm (5,39). The conclusions of this study are (1) the length of the stem of banana fibres in composite will further improve the tensile strenght on an existing specimen, by not being influenced by other factors, (2) The length of the stem of banana fibres will be increasingly small elongation that occurred compared with shorter fibres, and (3) the length of the stem of banana fibres are the higher values of the strain that occurs.

Keywords: the length of fibre, the stem of banana, tensile strenght

INTRODUCTION

The tensile strength is the waste from banana crop has been cleared for the rosaceae and agricultural waste is a potential that has not been much used. The composite is a material that is formed from a combination of two or more materials whose mechanical properties of constituent materials. Composite consists of two parts namely the matrix as a binder or protective composite and composite filler as filler. Natural fibre composite filler is a great alternative for a wide range of polymer composite because its superiority compared to synthetic fibres. Natural fibres are easily obtained at low prices, easy processing, low, its are environmentally friendly and can be described in biologist (Kusumastuti, 2009).

Fiber obtained from the stem of banana tree fibre has good mechanical properties. Mechanical properties of fibres of the stem of banana has a density of 1.35 gr/cm, the 63-64% of cellulose, hemicellulose 20%, lignin 5%, the average tensile strength 600 Mpa tensile modulus, an average of 17.85 GPa and long added 3.36% (Lokantara, 2007). The diameter of the stem of banana leaf fibres is 5.8% , whereas the length of around 30,92-40,92 cm.

Suwanto (2006) have observed the influence of temperature post-curing composite tensile strength of epoxy resin reinforced with woven banana fibres. Maximum tensile strength that occurs on a composite experience a process of post curing temperature on 10000^{o}C of 42,82 MPa, an increase in tensile strength of 40,26% if compared to the composite without warming up. Tensile strength that occurs on a composite of smaller if compared to the tensile strength of material constituting the two. This can be caused by a high degree of porosity in fibre composites, conditions are less uniform, the on set of delamination between fibre and matrix, a low surface bonding between fiber and matrix.

Surani (2010) examined utilization of banana as raw fibre boards with thermo-mechanical treatment. Thermo-mechanical treatment is carried out through the establishment of mat wet way. The best fibre board quality is obtained at the treatment temperature of boiling 100^{0}C flakes without the use of synthetic adhesives. Syaiful Anwar (2010) examine the stem of banana stems is to know the influence of the length of the stem of banana leaf fibre 10 mm, 20 mm, 30 mm, 40 mm against the stem of banana leaf fiber tensile strength with

matric polyester. Study on the fiber used is the stem of banana leaf fibers with 50% volume fraction, fiber length of 10 mm, 20 mm, 30 mm, 40 mm.

The standard reference for the manufacture and testing of specimens used ASTM D 638-03 type I for tensile test. The results of the study concluded the specimen with an increasingly long fibres will be more durable in the hold the load pull because the long fibres have a more perfect structure that were installed along the axis of the fiber and internal defects on fiber less than the material fibers are short. Evi Indrawati (2010) states that the stem of banana leaf is one part of the banana which consists of a collection of the stem of the composition and grow erect. Fibre obtained from the banana is a strong fibre and has a high store and has cellular tissue with pores interconnected. Based on the background in this research existing problems the influence of long fiber of the klutuk banana, tensile strength while many banana is not explored. The results can be achieved is materially qualified natural and good.

LITERATURE REVIEW

Banana Fibre

Banana stems is a type of fibre that is of good quality, and is one of the potential alternative materials that can be used as a filler in composite manufacture polyvinyl chloride or commonly abbreviated PVC. The stem of banana waste can be used as a source of fibre in order to have economic value. Rahman (2006) states that the comparison between fresh weight of leaves, stems, and fruit of the banana row 63, 14, and 23%. The stem of banana has a kind of weight 0,29 g/cm with a length of fibre 4.20- 5.46 mm and lignin content 33,51% (Syafrudin, 2004).

Klutuk Banana

The banana is a kind of typical, not because it tastes sweet, but because his meat filled with black. The seeds have rough skin texture and a hard shell. The klutuk banana tree traits has a height up to 3 meters with trunk circumference ranging from 60 cm to 70 cm. Stem is green with or without patches of spots. Klutuk banana tree leaf is usually along 2 metre with lenar 0.6 metres. Its leaves if noted in details seem thin wax layer has a unique and not easy to rip like other types of banana leaves.

Composite

Composite is a combination of two or more different materials, and it is made to acquire properties that are better are not retrieved from the respective compilers composite (Fajriyanto and Firdaus, 2007). Composites consist of a matrix as a fixed phase and filler and the second phase is separated by interface condition. The resulting composite material depends on the matrix and the matrix filler material used. Each composite that is made with different materials, then the nature of that form will be different and depending on the type of filler material, filler and matrix material for amplifiers are used (Hanafi, 2004).

Tensile Testing

Tensile testing is used to determine the mechanical properties of a material, such as the maximum tensile strenght. A test object that is used is solid and there are some cylindrical, shaped sheet and plate-shaped pipes in a variety of sizes. A specimen is then gripped between the two pegs on the test machine is equipped with a variety of control so that specimens can be tested.

MATERIALS AND METHODS

The tools and materials used in this research is the Universal Testing Machine with a maximum capacity of 500 kg specification and control of automated testing and stem fiber banana as a composite. This research method using hand lay-up include the preparation of

molds, coating, alignment, and drying. After taking a fibre made by selecting the stem of banana leaf that is still in a state of good, moist, and start to dry out, discard the leaves on the stem of banana leaf and cut the stem of which is already drying up, release the outer skin of the stem of banana leaf, drying out is carried out in a place not exposed to direct sunlight.

Then do the creation of samples. Manufacture of composite refers to the standard ASTM D-3039. A homogeneous mixture is poured in the mold of mold size tension-test leveled with a brush.

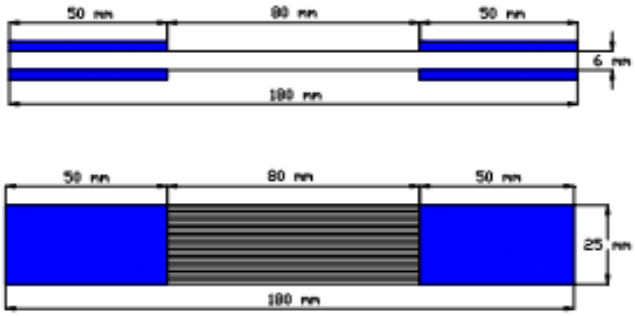


Figure 2: Sample of tensile strenght test

Scheme for sample fibre tensile strength test of the stem of banana leaf arranged lengthwise above the mold parallel with the size of the mold. The repeated these steps for samples 1, 2, 3 and 4, with a length of fiber is a variation of 10 cm, 7 cm, 5 cm and 3 cm. After making a sample done, drained for 24 hours, then made the characterization of the mechanical properties of the composite is a strenght testing.

RESULTS AND DISCUSSION

The Results

This research use the equipment Universal Testing Machine. Tensile test specimen made in the form of a composite plate manufactured by the method of hand lay-up. The geometry and dimensions of specimen tensile test customized standard ASTM D 3039. Set-up tool test on static tensile tests tailored to the holder of the specimen on the tension testing machine. Tensile loading provided parallel to the axis of the axial and is assumed to be uniform in every point of testing.

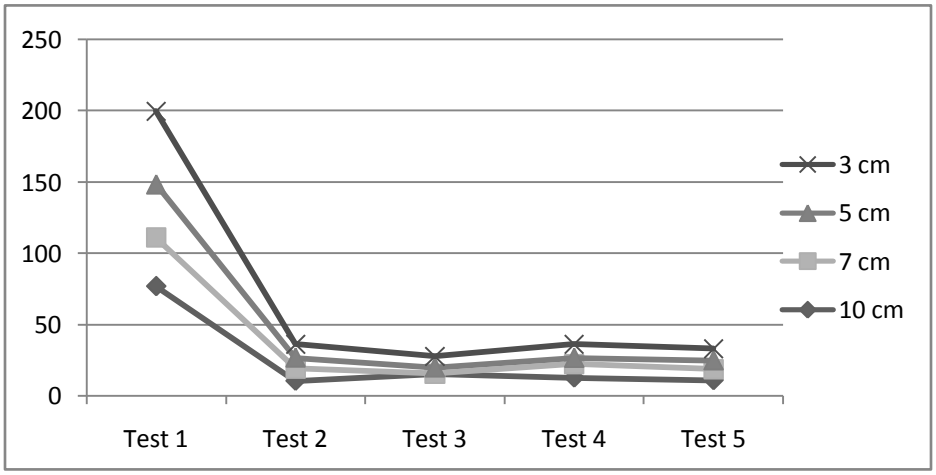
Tensile test specimen holder are designed in accordance with the test tool holder to be used as a specimen holder shaped plates. In order to be considered the holder of the specimen must be capable of holding the specimen with strong and attempted to slip does not occur. Tensile measurement of tensile specimen based on the theory of Hooke's Law. The theory states that a materials behave in an elastic and showed a relationship between stress and strain liniear called elastic finite. Variables that will be observed in this study i.e. tensile strenght so that the maximum tensile stresses get value added, the length of which indicates the strain that occurs.

Table 1: The Results of Tensile Testing

No.	Specimen	Area Max (mm2)	Max Force (N)	Tensile Strenght (N/mm2)	Break Force (N)
1.	10 cm	25.000	1935.6	38.71	689.90
		124.400	1311.6	10.30	585.97
		124.400	1932.9	15.17	910.62

		124.400	1598.5	12.55	759.11
		124.400	1317.4	10.77	600.88
2.	7 cm	25.000	849.9	17.00	420.45
		124.400	1075.7	8.44	400.64
		124.400	1570.4	12.33	777.04
		124.400	1165.3	9.15	503.61
		124.400	935.7	7.35	432.40
3.	5 cm	25.000	937.6	18.75	468.20
		124.400	954.7	7.49	439.86
		124.400	547,4	4.30	272.35
		124.400	557.6	4.38	261.76
		124.400	793.9	6.23	378.33
4.	3 cm	25.000	1280.4	25.61	591.94
		124.400	1175.8	9.23	467.86
		124.400	981.8	7.71	489.15
		124.400	1192.5	9.36	514.65
		124.400	1024.2	8.04	445.49

(Sources: primary data, 2014)



(Sources: primary data, 2014)

Figure 1: The Comparation of Tensile Strenght in Specimen 10 cm, 7 cm, 5 cm and 3 cm

Discussion

The test results showed that the composite fibres strength stem of banana leaf with a tensile strenght test result was consecutive from the highest is specimen 10 cm (25.38 N/mm^2), specimen of 7 cm (14,47 N/mm^2), specimen of 3 cm (17,27 N/mm^2) and specimen of 5 cm (12,08 N/mm^2). The results of the extension and the strain that occurs in row are specimen of 10 cm (20,14), specimen of 7 cm (9.95), specimen of 5 cm (5,49) and specimen of 3 cm (5.39).

Table 2: Analysis of Results Tensile Strenght

No.	Specimen	Area Max (mm2)	Max Force (N)	Tensile Strenght (N/mm2)	Break Force (N)	Elongation	Strain
1.	10 cm	25.000	1935.6	77	689.90	1,26	**20,14**

		124.400	1311.6	10.54	585.97	1,27	
		124.400	1932.9	15.53	910.62	1,26	
		124.400	1598.5	12.85	759.11	1,25	
		124.400	1317.4	11.02	600.88	1,27	
	Mean (1)			**25,38**		**1,26**	
2.	7 cm	25.000	849.9	33,99	420.45	1,42	
		124.400	1075.7	8,65	400.64	1,43	
		124.400	1570.4	12,63	777.04	1,47	**9,95**
		124.400	1165.3	9,37	503.61	1,46	
		124.400	935.7	7,52	432.40	1,48	
	Mean (2)			**14,43**		**1,45**	
3.	5 cm	25.000	937.6	37,5	468.20	2,0	
		124.400	954.7	7,67	439.86	2,1	
		124.400	547,4	4,40	272.35	2,3	**5,49**
		124.400	557.6	4,48	261.76	2,4	
		124.400	793.9	6,38	378.33	2,1	
	Mean (3)			**12,08**		**2,2**	
4.	3 cm	25.000	1280.4	51,23	591.94	3,2	
		124.400	1175.8	9,45	467.86	3,1	
		124.400	981.8	7,89	489.15	3,5	**5,39**
		124.400	1192.5	9,58	514.65	3,3	
		124.400	1024.2	8,23	445.49	3,2	
	Mean (4)			**17,27**		**3,2**	

(Sources: primary data, 2014)

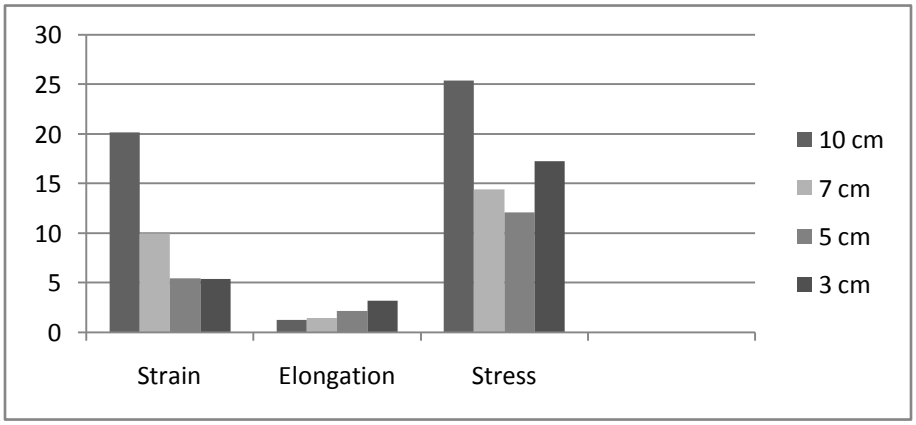


Figure 2: The Comparation Strain, Elongation dan Stress in Specimen 10 cm, 7 cm, 5 cm and 3 cm

Based on the results of these tests, that the length of the stem of banana leaf fibres will be higher tensile stresses, though there is still a difference between specimen of 5 cm and 3 cm, this is because due to factors outside of testing such as the making of the specimen is still not perfect and the density of specimens of different factions. It can be seen from the strain that occurs that is the length of the stem of banana leaf fibres would further increase the strain these specimens, so the stem of banana leaf fibre length factor affects the value of the voltage drop and the strain that occurs. Besides the comparison judging from length (elongation) that the length of the stem of banana leaf fibres will be inversely proportional to the extension took place, namely the length of the fiber will be getting smaller in comparison with the long stem of the short fibres.

CONCLUSION

Based on research that has been done can be inferred that the tensile strenght obtained:

1. The length of the stem of banana leaf fibres in composite will further improve the tensile strenght on an existing specimen, by not being influenced by other factors.
2. The length of the stem of banana leaf fibres will be increasingly small elongation that occurred compared with shorter fibres.
3. The length of the stem of banana leaf fibres are the higher values of the strain that occurs.

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