ISBN : 978-602-99806-3-9

TEST VIBRATION IN TREATMENT OF AGAVE FIBER AND BAMBOO FIBER TO VARIATION OF FAKE DIRECTION

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This study aims to (1) analyze the effect of agave fiber and bamboo fiber treatment on tensile strength and adhesive ability as composite material; (2) to analyze the effect of variation of vibrator placement on personal frequency and stiffness in composite beam agave fiber and bamboo fiber, analyzed the effects of variations in the direction of the fibers (0°/0°/0°), (-45°/0°/45°), and (-90°/0°/90 °) on the personal frequency and stiffness of the fiber composite agave and bamboo fiber, (4) comparing experimental analysis with numerical effect of variation of fiber direction from vibration test result using finite element method. This study uses finite element method for numerical analysis and spectrum method for experimental analysis. For finite element method in numerical analysis, the stem is divided into 5 elements while for the experimental analysis is done 4 eksposimental placement of eksiter, the pedestal used is simple. Material of the test material used is the composite beam of agave fiber and bamboo fiber. The treatment process of agave fiber and bamboo fiber using alkaline solution (NaOH) and Ethanol solution (C2H5OH) with soaking time of 1 hour and 3 hours for the first year. And for the second year it is planned to treat agave fiber and bamboo fiber, using alkali (NaOH) and Ethanol (C2H5OH) solution with 2 hours and 4 hours immersion time with 10%, 20%, 30%, and 40% %.

Keywords: tensile strength, modulus of elasticity, stiffness

INTRODUCTION

Image "Green" attached to natural fibers, paving the way for natural fibers for product innovation and development in the last decade, for example the development of fiber reinforced composites in the automotive industry, building construction, geotextiles and agricultural products. Although natural fibers have been used in a variety of applications, extensive research should be undertaken to further explore the given treatment shape and to optimize the potential of natural fibers and to obtain new types of fibers.

Various types of natural fibers have been explored to produce valuable composite materials that have been produced such as flax, hemp, kenaf, sisal, abaca, hemp and others. Benefits of using composites include light weight, corrosion resistance, water resistance, performance is attractive, and without machining process. Natural fibers are easy to obtain at low prices, easy to process, environmentally friendly, and biologically elaborated.

Agave fiber is a natural fiber derived from pineapple tree, where pineapple tree is a plant that grows spread in some areas of Indonesia. The manufacture of natural fiber reinforced composites (agave fibers) is intended to find alternative composite materials that are less dependent on synthetic fibers (Santoso, 2008).

In determining the mechanical properties of composite structures, there are several factors that influence, such as orientation of fiber direction in the composite material as the amplifier and the volume fraction of fiber used. The placement of fibers with a certain direction angle in composite maktriks is

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intended to allow the tension to be uniformly distributed on the fiber parts to provide good rigidity. One of the advantages of composite materials is that it can accept loads in certain directions, meaning they are only strong and rigid in certain directions and weak in undesirable directions. This capability is clearly not possessed by isotropic materials having the same strength and stiffness in all directions.

Taurista, et al (2006) conducted a study on bamboo fiber which aims to determine the tensile strengt h and bending strength on fiber width variation. The largest actual tensile strength test result is composite with a width of 5 mm fiber with actual value of 16,806 Kg / mm2. The largest tensile strain is composite with a width of 5 mm fiber with εaktual value of 0.012. While the largest tensile elastic modulus is composite with a width of 5 mm fiber with a value of 1421,129 kg / mm2. The largest bending strength is owned by a composite with a width of 5 mm fiber with a value of 17.60533 kg / mm2. These results are eligible for ship leather material applications, according to BKI standards (Bureau of Classification Indonesia).

Wijoyo et al (2011) conducted research on pineapple fiber surface to investigate the effect of pineapple fiber surface treatment (Ananas comosus L. Merr) on tensile strength and adhesive ability with unsaturated polyester type 157 BQTN-EX matrix. Test results show the effect of pineapple fiber treatment with alkhali solution and ethanol solution can increase tensile strength and compatibility in fiber.

Vibration is one of the most important issues in machine construction planning. When the frequency of the excitation force coincides with one of the personal frequencies of the system, the resonance condition occurs and produces a large deviation. The characteristics of vibration in the composite stem are influenced by the dimension and modulus of elasticity. A large elastic modulus will produce natural material frequencies and large material stiffness. The effect of positioning of the vibrating position will have an impact on the frequency value and stiffness of the material, the closer to the vibrating position on the pedestal will provide great rigidity and natural frequency (Endrianto, 2012).

In this research will be developed the use of composite material that is agave fiber and bamboo fiber which is treated on the surface of both fibers with alkhali and ethanol solution, then the vibration test is done on simple support system (jepit-roll). As a numerical analysis solution used finite element method with the help of numerical computation program Matlab (Labolatory Matrix), and vibration spectrum analysis used to analyze the vibration of composite beam by experimental method.

METHODOLOGY

1.1. Test Specimen Testing Technique

Specimens of agave fibers and bamboo fibers were prepared with two treatments each with an immersion treatment with an alkaline solution (10% NaOH, 20%, 30%, 40%) and immersion of 10%, 20%, 30%, 40% ethanol solution with variation soaking 1 and 3 hours. The test samples were then tested for tensile strength. For the compatibility test specimens on agave fibers 10%, 20%, 30%, 40% NaOH and 10%, 20%, 30%, 40% ethanol solutions at one end of the agave fiber were deposited with resin. The size of the fiber tensile test specimen conforms to the JIS K-7601 reference standard as Fig. 1. As for compatibility testing according to JISR-3420.

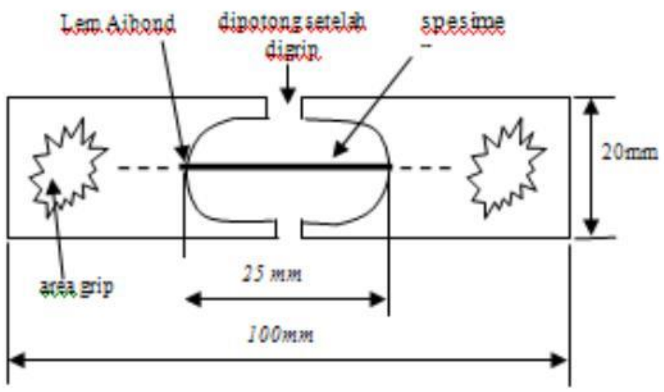

Figure 1. Tensile fiber test specimens

1.2. Form of material for tensile test

The shape of the material for tensile test with its dimensions is addressed in the following figure based on American Society For Testing and Materials (ASTM) D-790:

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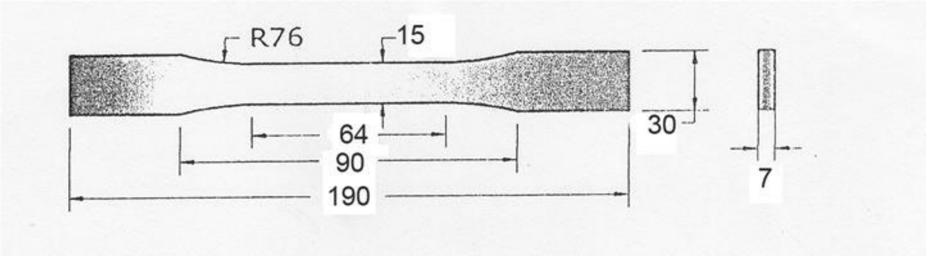

Figure 2. Material shape and dimensions for tensile test

Tensile Test Procedure
1. The test machine is turned on and set to zero
2. The specimen is mounted on the subsequent clamps the tap is locked.
3. Set the oil flow rate.
4. Notes the value of the load occurring on the specimen each step or any extension thereof, until the specimen is broken.
5. Remove the specimen that has been broken and shut off the test machine.
6. Repeats the a-e procedure for another specimen.

1.3. Vibration Tester Procedures

The agave fiber and bamboo fiber composite beams are supported on the cantilever, where the vibrating motor (Eksiter) is varied at 10 cm, 20 cm, 30 cm and 40 cm positions. Implementation stage of vibration testing as follows:
1. Install the composite beam on the clasp well.
2. Put the vibration sensor on the top of the tongs.
3. Put the eksiter (vibrator motor) on the specimen in accordance with the desired position.
4. Turn on the motor vibrator (ON).
5. Taking vibration data from the vibration sensor device
6. Repeat step a-f for exciter position and other fiber direction composition.

Vibration testing data retrieval scheme can be seen in the following figure :

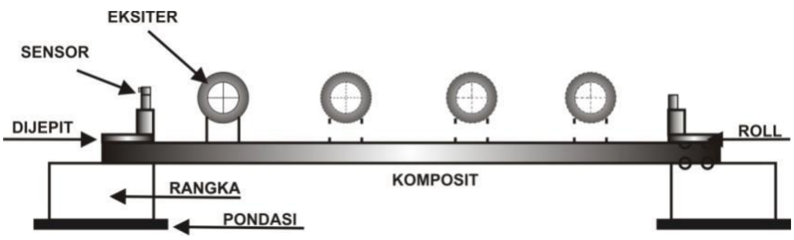

Figure 3. Data retrieval scheme

RESULT AND DISCUSSION
2.1. Agave Fiber Treatment

Table 2.1.1. Tensile test of agave fiber with 1 hour NaOH solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	625.186	3.123
2	20	840.918	4.653
3	30	1021.351	6.216
4	40	810.634	4.023

ISBN : 978-602-99806-3-9

Table 2.1.2. Tensile test of agave fiber with 3 hour NaOH solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	631.424	4.037
2	20	743.216	6.123
3	30	405.920	3.598
4	40	451.019	5.377

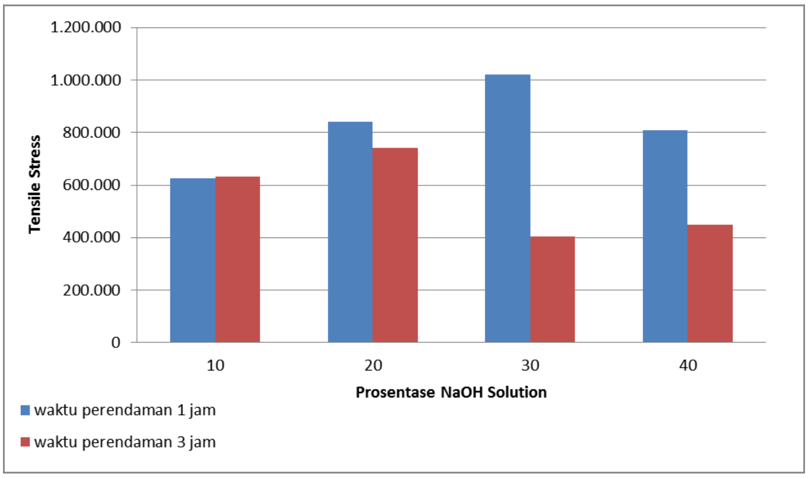

Figure 2.1.1. Tensile Stress Agave Fiber on Percentage of NaOH Solution

In table 2.1.1., the agave fiber tensile test results with 1 hour NaOH solution, visible tensile stress tends to increase as percentage of NaOH solution. Likewise elongation is also happening. In percentage of 40% NaOH solution, tensile and elongation stress decreases.

In table 2.1.2., The result of agave fiber tensile test with 3 hours of NaOH solution, visible tensile stress tends to decrease as percentage of NaOH solution. Similarly, the elongation is also smaller.

Figure 5.2.1 shows clearly the percentage of NaOH solution at 1 hour immersion, has a higher tensile stress and elongation value along with the increase of percentage percentage of NaOH solution. But at a very high percentage rate, the value of tensile stress and elongation has dropped. In contrast to the percentage of NaOH solution at 3 hours of immersion, the value of tensile stress and elongation tends to decrease as the percentage of NaOH solution increases.

Tabel 2.1.3. Tensile test of agave fiber with 1 hour Ethanol solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	968.072	2.500
2	20	1054.670	2.366
3	30	1179.814	1.766
4	40	1589.770	2.475

Tabel 2.1.4. Tensile test of agave fiber with 3 hour Ethanol solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	946.171	1.756
2	20	472.570	1.756
3	30	630.442	2.400
4	40	584.335	2.313

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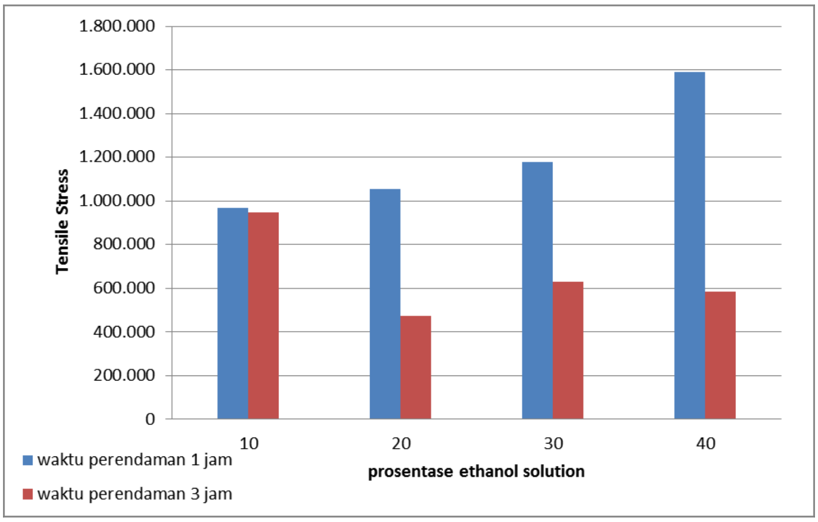

Figure 2.1.2. Tensile Stress Agave Fiber on Percentage of Ethanol Solution

In Table 2.1.3, the result of tensile test of agave fiber with Ethanol solution 1 hour, visible tensile stress tends to increase as percentage of NaOH solution. Likewise elongation is also happening.

In Table 2.1.4, the agave fiber tensile test with 3 hours Ethanol solution showed that tensile stress and elongation tend to decrease along with the increase of percentage of NaOH solution. the same is also shown in Figure 2.1.2.

2.2. Treatment of bamboo fiber

Table 2.2.1. Tensile test of bamboo fiber with 1 hour NaOH solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	525.176	2.123
2	20	740.918	4.513
3	30	921.351	6.766
4	40	810.534	4.053

Table 2.2.2. Tensile test of bamboo fiber with 3 hour NaOH solution

No	Prosentase	Tensile Stress	Elongation (%)
1	10	531.424	4.037
2	20	644.236	6.113
3	30	425.930	3.578
4	40	453.039	5.310

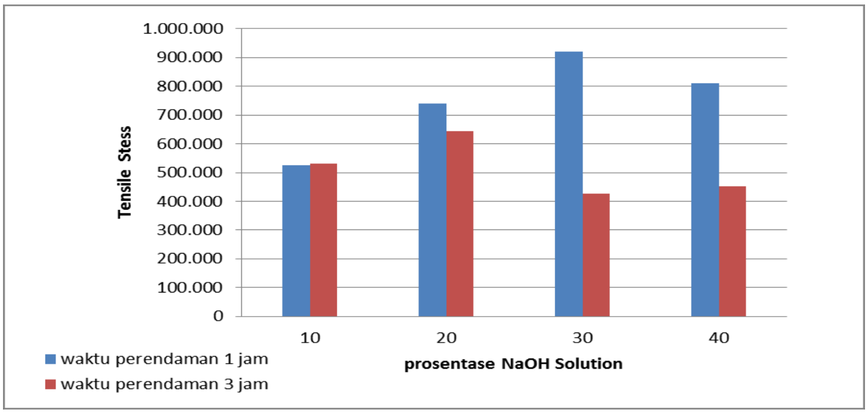

Figure 2.2.1. Tension of Bamboo Fiber at the Percentage of NaOH Solution

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In Table 2.2.1. and Table 2.2.2., a bamboo fiber tensile test with 1 hour and 3 hour NaOH solution showed a not-so-significant increase when compared to agave fiber tensile test results.

It can be concluded that NaOH solution has properties that can change the surface of the fiber becomes rough, due to the increasingly rough fiber will cause the tensile strength is decreased after exceeding the saturation limit.

Tabel 5.2.3. Tensile test of bamboo fiber with 1 hour Ethanol solution

No	Prosentase	Tegangan tarik	Elongation (%)
1	10	825.186	2.123
2	20	940.918	4.688
3	30	1021.361	6.900
4	40	1102.544	7.041

Tabel 5.2.4. Tensile test of bamboo fiber with 3 hour Ethanol solution

No	Prosentase	Tegangan tarik	Elongation (%)
1	10	940.600	4.069
2	20	760.236	4.049
3	30	625.930	3.568
4	40	453.039	3.210

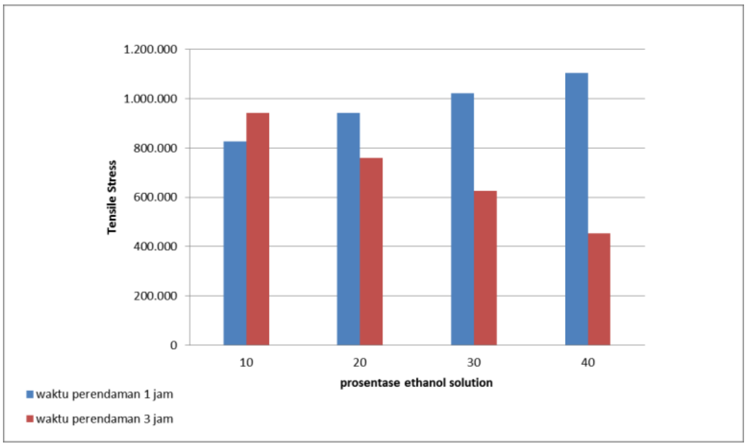

Figure 2.2.1. Tension of Bamboo Fiber at the Percentage of Ethanol Solution

Soaking with soluble ethanol gives the effect of increasing the tensile strength of agave and bamboo fibers, but the addition of ethanol content will decrease the value of elongation of agave fiber and bamboo fiber.

2.3. Vibration test

Table 2.3.1. Result of Personal frequency test and stiffness for Agave fiber composite - epoxy matrix with variation of fiber direction.

NO	The direction of Serat Agave (°)	Exit Position (Cm)	m (kg)	ω_n (rad/s)	k (kg/m)
1	0°/0°/0°	10	0,074	4470,2	369679,7287
		20		3657,97	247543,7736
		30		2630,14	127976,2738
		40		1510,11	42187,99592
2	-45°/0°/45°	10	0,074	4040,13	301969,0327
		20		3359,8	208832,7367

ISBN : 978-602-99806-3-9

		30		2200,01	89540,814
		40		1389,29	35707,34403
3	-90°/0°/90°	10	0,074	3789,99	265734,4477
		20		3120,31	180122,1882
		30		2240,6	92875,33466
		40		1337,63	33101,19931

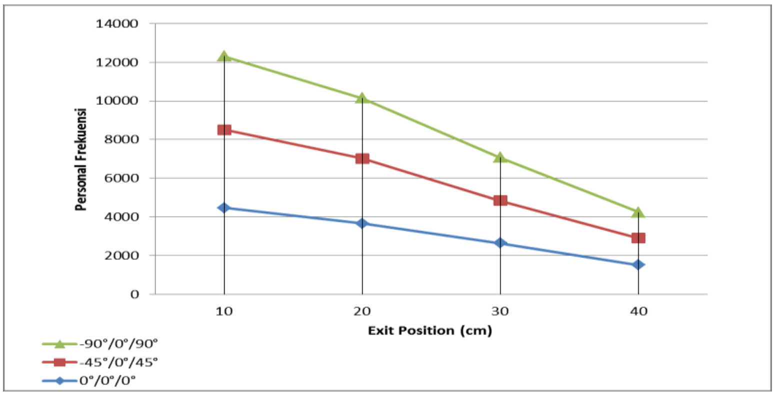

Figure 2.3.1. Graphic Relation Frequency Personals Fiber Agave Vs Position of Rangers

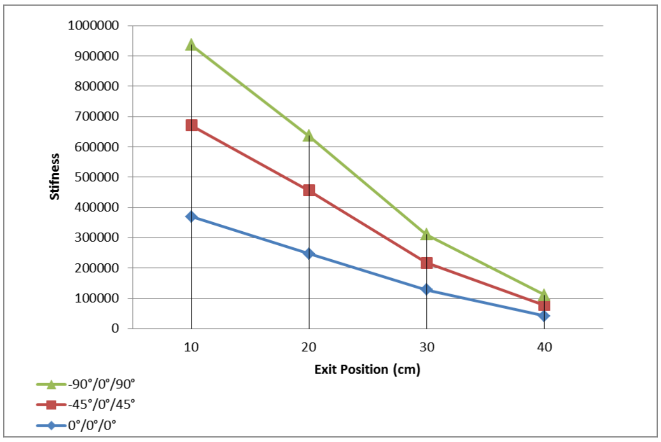

Figure 2.3.2. Graph of Rigidity Relationship Fiber Agave Vs Position of Razors

Table 2.3.2. Result of Personal frequency test and stiffness for Bamboo fiber composite - epoxy matrix with variation of fiber direction

NO	Arah Serat Ijuk (°)	Posisi Eksiter (Cm)	m (kg)	wn (rad/s)	k (kg/m)
1	0°/0°/0°	10	0,082	4040,02	334596,1128
		20		3360,17	231460,2198
		30		2409,33	118999,8565
		40		1407,66	40620,88685
2	-45°/0°/45°	10	0,082	3639,53	271546,6617
		20		3019,42	186896,3913
		30		2130,43	93044,00569
		40		1250,19	32040,98824
3	-90°/0°/90°	10	0,082	3449,71	243960,2312
		20		2869,66	168816,4446
		30		2009,4	82772,61138
		40		1179,39	28514,69583

ISBN : 978-602-99806-3-9

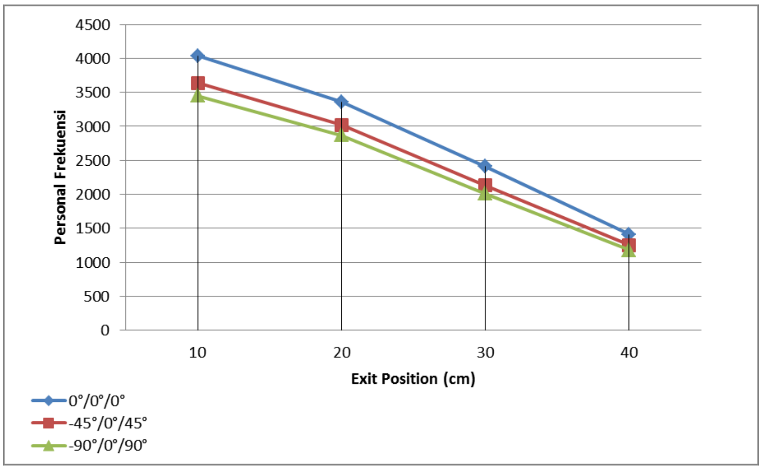

Figure 2.3.3. Graph of the Relation of the Personal Frequency of Bamboo Fiber vs. the Position of the Rangers

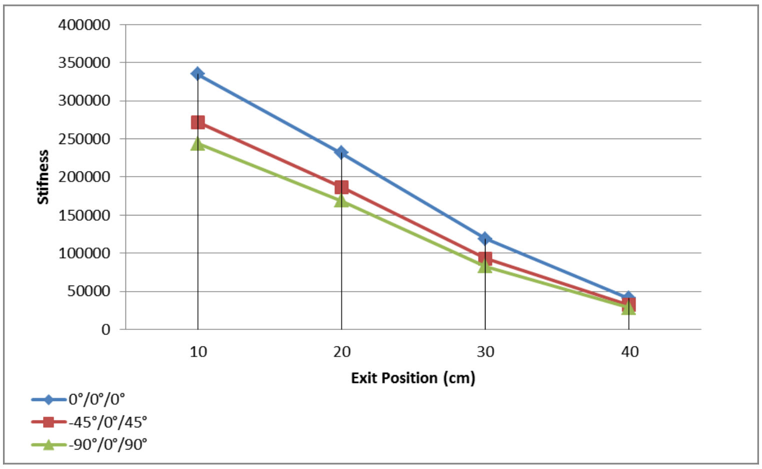

Figure 2.3.4. Graph of Stiffness of Bamboo Fiber vs. Position of Rangers

In agave fibers, the personal frequency values and composite stiffness are affected by the direction of the fibers, the maximum occurs in the -90º/0º/90º direction with values ω_{nmax} = 3789.99rad /s, k_{max} = 265734.4477 kg /m and minimum in direction 0°/0°/0º with value ω_{nmin} = 4470.2 rad/s, k_{min} = 369679.7287 kg /m.

In agave fibers, the personal frequency value and composite stiffness decreased as the exit position increased from the clamp pedestal, the maximum occurred in the direction of 0º/0º/0º for the 10 cm exiter position with the value ω_{nmax} = 4470.2 rad /s, k_{max} = 369679.7287 kg /m and minimum at the -90º/0º/ 90º direction for exciter position of 40 cm with value ω_{nmin} = 1337.63 rad/s, k_{min} = 33101.19931 kg/m.

In bamboo fiber, personal frequency values and composite stiffness are affected by the direction of fiber, the maximum occurs in the direction of 0º/0º/0º with the value ω_{nmax} = 4040.02 rad/s, k_{max} = 334596,1128 kg/m and minimum in direction -90°/0º/90º with the value of ω_{nmin} = 3449.71 rad/s, k_{min} = 243960.2312 kg / m.

In bamboo fiber, the personal frequency value and composite stiffness decreased as the exit position increased from the clamp pedestal, the maximum occurred in the direction of 0º/0º/0º for the 10 cm exiter position with the value ω_{nmax} = 4040.02 rad/ s, k_{max} = 334596,1128 kg /m and minimum at the -90º/0º/ 90º direction for exciter position of 40 cm with value ω_{nmin} = 1179,39 rad/s, k_{min} = 28514.69583 kg/m.

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CONCLUSION

1. Effect of agave fiber treatment on immersion for 1 hour and 3 hours in 10%, 20%, 30% and 40% alkali (NaOH) solution can increase tensile strength especially on fiber with 1 hour treatment while in fiber treated by NaOH for 3 hour tends to drop its tensile strength.
2. Effect of agave fiber treatment on immersion for 1 hour and 3 hours at 10%, 20%, 30% and 40% ethanol solution also showed optimum tensile strength at 1 hour treatment compared with 3 hours treatment.
3. Effect of bamboo fiber treatment on soaking for 1 hour and 3 hours in 10%, 20%, 30% and 40% alkali (NaOH) solution can increase tensile strength especially on fiber with 3 hours treatment.
4. Effect of bamboo fiber treatment on immersion for 1 hour and 3 hours at 10%, 20%, 30% and 40% ethanol solution also showed optimum tensile strength at 3 hours treatment compared with 1 hour treatment.
5. In agave fibers, the personal frequency values and composite stiffness are affected by the direction of the fibers, the maximum occurs in the -90º/0º/90º direction with values ω_{nmax} = 3789.99rad /s, k_{max} = 265734.4477 kg/m and minimum in direction 0º/0º/0º with value ω_{nmin} = 4470.2 rad/s, k_{min} = 369679.7287 kg /m.
6. In agave fibers, the personal frequency value and composite stiffness decreased as the exit position increased from the clamp pedestal, the maximum occurred in the direction of 0º/0º/0º for the 10 cm exiter position with the value ω_{nmax} = 4470.2 rad /s, k_{max} = 369679.7287 kg /m and minimum at the -90º/0º/ 90º direction for exciter position of 40 cm with value ω_{nmin} = 1337.63 rad/s, k_{min} = 33101.19931 kg/m.
7. In bamboo fiber, personal frequency values and composite stiffness are affected by the direction of fiber, the maximum occurs in the direction of 0º/0º/0º with the value ω_{nmax} = 4040.02 rad/s, k_{max} = 334596,1128 kg/m and minimum in direction -90º/0º/90º with the value of ω_{nmin} = 3449.71 rad/s, k_{min} = 243960.2312 kg / m.
8. In bamboo fiber, the personal frequency value and composite stiffness decreased as the exit position increased from the clamp pedestal, the maximum occurred in the direction of 0º/0º/0º for the 10 cm exiter position with the value ω_{nmax} = 4040.02 rad/ s, k_{max} = 334596,1128 kg /m and minimum at the -90º/0º/ 90º direction for exciter position of 40 cm with value ω_{nmin} = 1179,39 rad/s, k_{min} = 28514.69583 kg/m.

BIBLIOGRAPHY

[1] Fausan. 2007. **"Analisis Getaran Torsional Pada Poros Bulat dengan Metode elemen Hingga Berbasis Matlab".** Tesis tidak dipublikasikan, Makassar.
[2] Nanang Endrianto . 2012. "Analisis Numerik dan Eksperimental Getaran Balok Komposit yang diperkuat Serat Abaca". Tesis tidak dipublikasikan, Makassar.
[3] Santoso. 2008, " Potensi Bahan Baku Komposit Serat Agave Dalam Ruang Lingkup Industri" Lembaga Penelitian dan Pengabdian Pada Masyarakat (LP3M) Institut Pertanian, Malang.
[4] Steven T. Karis. 2007. "Numerical Analysis Using Matlab and Excel". Orchard Publications, USA.
[5] Taurista, dkk. 2006 "*Komposit Laminat Bambu Serat Woven Sebagai Bahan Alternatif Pengganti Fiber Glass Pada Kulit Kapal",* Jurusan Teknik Material, Institut Teknologi Sepuluh Nopember, Surabaya
[6] Van Vlack . 1989. "Elemen-elemen Ilmu Dan Rekayasa Material".PT. Erlangga, Jakarta.
[7] Van Vlack . 1990. "Ilmu Dan Tekhnologi Bahan". PT.Erlangga , Jakarta.
[8] Wijoyo, dkk, 2011, Pengaruh Perlakuan Permukaan Serat Nanas (*Ananas Comosus L.Merr*) Terhadap Kekuatan Tarik Dan Kemampuan Rekat Sebagai Bahan Komposit, Procedding Mekanika volume 9 no 2, Universitas Surakarta.
[9] William T. Thomson . 1986. " Teory Getaran Dengan Penerapan". PT.Erlangga, Jakarta.