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Damping Test on Flax and Sisal Hybrid Composites Reinforced with Epoxy Resin

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ABSTRACT

The aim of this study is to evaluate frequency, material damping factor, magnitude and phase angle of the composite plate of hybrid sisal and flax reinforced with epoxy resin composites. The hybrid sisal-flax laminations are prepared by hand lay-up technique. Sisal and flax fiber as reinforced materials and commercially available epoxy resin as a matrix material. A cantilevered rectangular symmetric plate of hybrid sisal-flax fabric reinforced epoxy composite having dimensions 300x300x5 mm. Damping factor can be varied by taking three different combinations of sisal fiber flax fiber and epoxy resin.

KEYWORDS: Damping, Sisal fiber, Flax fiber, Epoxy resin,Fast Fourier Technique

1. INTRODUCTION

The Fast Fourier Technique (FFT) is a fundamental measurement that isolates and inherent dynamic mechanical properties of the structure. Frequency, damping and mode shapes will be obtained from the Fast Fourier Technique. The Damping test specimen as shown in Figure 1

In Figure 2.experimental setup as shown, a matrix of 7x6 (42 nodes) estimation nodes are set apart over the surface of the laminates. The laminate is then braced on test apparatus and an impulse method was utilized to energize the structure by effect hammer with force transducer worked into the tip to enrol the force input. The impact force of the hammer will be within the 4-6 KN will be taken. Beyond the 6 KN or before the 4 KN and force of frequency not be accepted and the rebounding frequency also not accepted. The excitation signal is encouraged to the analyser through amplifier unit. A piezoelectric accelerometer stuck on the wanted measuring purpose of the specimen detects the subsequent vibration reaction. The accelerometer signals were molded in the charge amplifier and fed to the analyser. The analyser in conjunction with Fast Fourier Transform (FFT) gives connection amongst time and Frequency Response Spectrum (FRS) and intelligence capacities are enlisted in the chose recurrence range. At every lattice point five estimations were made and their average was obtained.

Figure 1. Damping test specimen

Figure 2. Experimental setup

2. METHODOLOGY

For various composition the stages involved in hand lay-up process are as follows: Cut down the fibers as per the required Length. Place the ASTM standard die. Wax a releasing agent can be applied to the die.Lay up the mixture of separate parent fibers. Sisal fiber and flax fiber percentage can be taken placed in the die. The epoxy resin mixed with a hardener with a percentage can be poured on the die uniformly. Allow a Curing time of about 24 hours and then separate the composite plate. These procedure continues for various combination.

Table 1.Fiber combination

Sl.No	Reinforcement Fiber	Matrix	Method of fabrication
1	Sisal (20%) +Flax (5%)	Epoxy Resin(LY-556) 75%	Hand layup process
2	Sisal (20%) +Flax (10%)	Epoxy Resin(LY-556) 70%	

3. EXPERIMENTATION

The yield information of every one of the 42 estimations was utilized as an information for LABVIEW-2009 software to recognize response frequencies. The natural frequencies, damping factor and mode shapes for various laminates were obtained for various combination.

Table 2.sisal+flax+epoxy resin composition

Polymer matrix composite	Mode number	Frequency Hz	Material damping factor	Magnitude $\frac{m^2}{s} - N$	Phase angle Degree
20% Sisal+5% Flax+75% Epoxy resin	1	21.150	1.807	0.048804	165.65
	2	48.082	2.510	0.012122	179.82
	3	151.795	2.430	0.945035	170.75
	4	173.365	2.406	0.280577	178.18
	5	290.085	1.045	1.152303	161.95

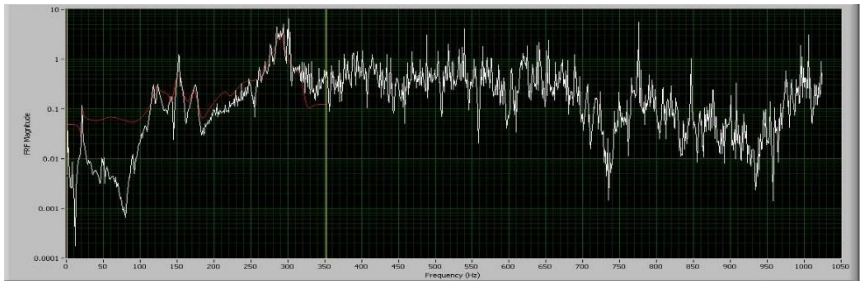

Figure 3.FRF sisal+flax+epoxy resin

Table 3.sisal+flax+epoxy resin composition

Polymer matrix composite	Mode number	Frequency Hz	Material damping factor	Magnitude $\frac{m^2}{s} - N$	Phase angle Degree
	1	19.373	0.732	0.120390	143.17

20% Sisal+10% Flax+70% Epoxy resin	2	40.209	1.211	0.006214	132.90
	3	118.362	2.943	2.031173	146.24
	4	144.124	1.181	0.239629	148.40
	5	232.136	0.822	0.801060	81.283

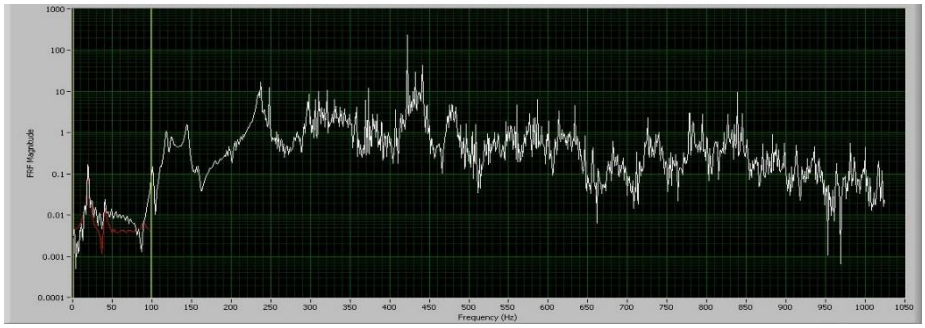

Figure 4. FRFsisal+flax+epoxy resin

4. RESULT AND DISCUSSION

Table 2 and table 3 shows corresponding values for frequency, material damping factor, magnitude and phase angle of the composite plate. The natural frequency (290.08 Hz) highly increases in 20% Sisal+5% Flax+75% Epoxy resin composite plate shown in table.2. The natural frequency (232.13 Hz) is comparatively low in 20% Sisal+10% Flax+70% Epoxy resin composite plate shown in table. 3

4.1 Mode shapes for 20%sisal+5%flax+75%epoxy resin

Mode Shape – 1 Mode Shape – 2Mode Shape - 3

Frequency – 21.150 Hz Frequency – 48.082 Hz Frequency – 151.795 Hz

Damping Factor – 1.807 Damping Factor – 2.510 Damping Factor – 2.43

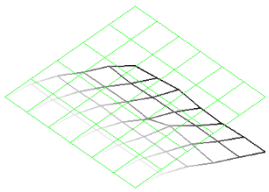

Figure 5.Bending

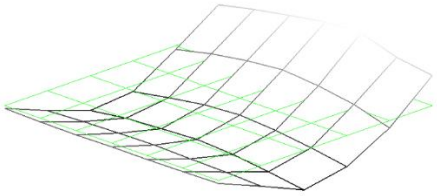

Figure 6. Twisting

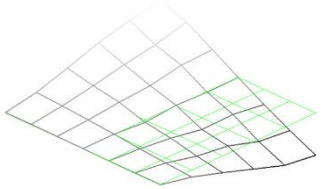

Figure 7. Double Bending

Mode Shape – 4

Frequency – 173.365 Hz

Damping Factor – 2.406

Mode Shape - 5

Frequency – 290.085 Hz

Damping Factor – 1.045

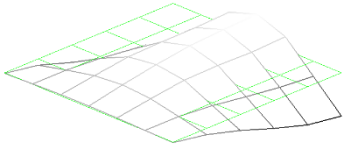

Figure 8. Combination of Bending and Twisting

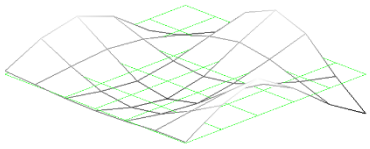

Figure 9. Complex mode

4.2 Mode shapes for 20%sisal+10%flax+70%epoxy resin

Mode Shape – 1 Mode Shape – 2Mode Shape - 3

Frequency – 19.373 Hz Frequency – 40.209 Hz Frequency - 118.362 Hz

Damping Factor – 0.732 Damping Factor – 1.211Damping Factor – 2.943

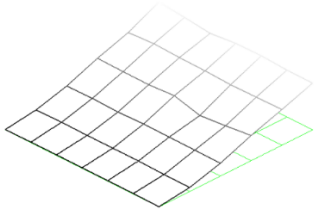

Figure 10.Bending

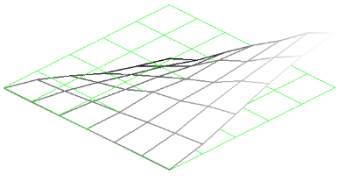

Figure 11. Twisting

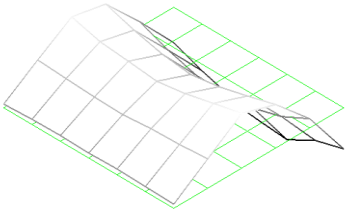

Figure 12. Double Bending

Mode Shape – 4 ModeShape - 5

Frequency – 144.124 Hz Frequency - 232.136 Hz

Damping Factor – 1.181Damping Factor – 0.822

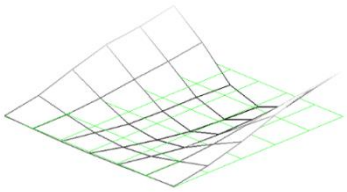

Figure 13.Combination of Bending and Twisting

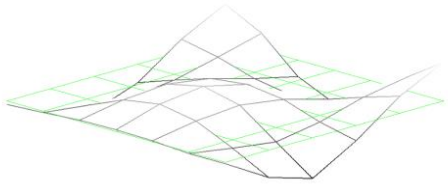

Figure 14. Complex

5. CONCLUSION

Natural frequency, damping factor and mode shapes are experimentally determined by using Fast Fourier Technique (FFT) analyser. This work shows that successful fabrication of different composition of sisal and flax hybrid composite materials are prepared by using hand lay-up technique. Damping test the natural frequency high for the combination 20% sisal+5% flax+75% epoxy resin laminates. The natural frequency low for the combination 20% sisal+10% flax+65% epoxy resin. The modal analysis for prepared specimen was carried out to find first natural frequencies, damping factor and corresponding mode shapes, for undertaken composition.

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