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Elastic Constant Measurement of Natural Fiber Reinforce Material of Phoenix Silvestre's

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Abstract- As the science is advancing; it is becoming more eco-friendly in perspective of more use of bio degradable, recyclable material in making goods in industries, engineering and household article. Natural fibers are good substitute of glass fibers and polythene as it is low weight, cheap and eco-friendly. In recent year natural fibers attracted the interest of researchers, engineers. Present study is an attempt to examine the elastic constant of reinforced material of phoenix sylvestris by measuring longitudinal sound velocity using ultrasonic interferometer in sequel young's modulus has been computed. Elastic properties are more important for engineering purpose.

Keyword- Natural fiber, Phoenix Sylvester's, Reinforce composite, elastic constant

I. INTRODUCTION

Nature provides us protein fiber such as keratin (feather), Fibroin and sericin (silk), chitin (insect exoskeleton, abalone) collagen (tendons) resilin (fleas) and cellulose fiber from plants. Natural fiber (NF) has some advantages over traditional fiber like glass and synthetic. The chemical composition of various parts of the date palm tree differed significantly with the highest amount of cellulose and lignin content belongs to rachis(1).Natural fiber reinforce composite appears to have bright future for wide range of application as well as due to low density less expensive and reduced solidity when compared to synthetic composites(2). Several studies have been done to examine the mechanical properties of natural fiber composite such as tensile test, compressibility, modulus of rupture elastic Constant etc. and results of studies are satisfactory to use NF as an alternative of synthetic and glass fiber. In order to produced cost effective polymer reinforced composites and to destruction of ecosystem researcher have started with new manufacturing trends using natural fiber(3). India is an agriculture based country in which wheat husk rice husk are in abundance during these crop. Some of part of these crop remains in field and burnt by farmer which may be good source of natural fiber (4).

Date palm tree plays a major role in human life. It has been used as a source of food, building houses and in cannels to divert water. The tree can decrease the atmospheric temperature, the level of pollutants in environment and highly able to tolerate drought and survive. There areseveral other aspects from the tree such as its wood is used to construction, making temporary bridge pier and tent pegs. Trunk sometimes treated as water conduit. Leaves are utilized in making mats, hand fans, baskets, bags, broomsticks etc.

Nondestructive evaluation (NDE) through Ultrasonic technique is reliable and accurate method for elastic characterization of a material. Different ultrasonic techniques appear as the best approaches in experimental solid mechanics. Keunecke et al (2007) have reported that the ultrasonic wave propagation have been well accepted for measurement elastic constant and frequently used.

II. METHODOLOGY

Sample preparation

Rachis (leaf base) of date palm tree is selected for preparation of wood powder because of richness of this part in term of cellulose. It is cut in small pieces and then grounded in a grinder. Later wood powder is filter and dried under the sun to avoid the moisture content in it. Wood properties are affected by moisture content. Few of them are modulus of elasticity, wave speed, attenuation which vary with moisture content (5).Dried wood powder is mixed with araldite gel (adhesive) to recast a specimen pellets (cubical). Such a mixture is placed in a metallic mould and compressed to form a specimen and dried at room temperature for a day. Specimen so obtained is treated chemically with NaOH and surface treatment (6) also carried out to avoid access of material.

Theory

Specimen is cemented to a quartz crystal rod of identical cross section and resonant frequency of the composite system (f_c) is determined using ultrasonic interferometer and resonance frequency of the specimen is calculated (7) using following relation$f_s=f_c+(m_q/m_c)(f_c-f_q)$

where f_s is resonance frequency of specimen, m_q is the mass of quartz crystal, m_c is mass of composite system, f_q is frequency of quartz crystal and f_c is the frequency of composite system

Ultrasonic velocity has been measured using following relation-

$v_l = 2.f_s.L$

(L is the length of specimen)

and young modulus (Y) has been calculated using following relation

$Y= v_l^2.\rho$

Where ρ is the density of the specimen

III. RESULT AND DISCUSSION

Measured and calculated value of different parameters have been displayed in table 1 which consist volume, density, resonance frequency longitudinal sound velocity and Young's modulus of specimen of different lengths. Solid wood cell have a density of 1,500 kg m^{-3} regardless of the wood species. It may vary with the thickness and volume of wood cells. The speed of sound in a structural material is a function of the modulus of elasticity and density. In wood, the speed of sound also varies with grain direction because the transverse modulus of elasticity is much less than the longitudinal value (as little as 1/20); the speed of sound across the grain is about one-fifth to one-third of the longitudinal value (8). The values for the NF are comparable with experimental values. The measured value of elastic constant using ultrasonic interferometer is first to reported in literature. Elastic constant is a parameter which defines the productivity of the material. Elastic constant is property of a material that defines material under goes a deforming stress and the stability of the materials. Young's modulus of NF reinforced material is increasing with increase in length of specimen. This may be a sign of applicability of NF reinforced material to be use instead of glass and synthetic fiber. To avoid error and spurious result, the limitations of the method must be kept in mind. Sample must be homogeneous at all structural scales neither too thin nor to porous (9). The mechanical properties of a single date palm fiber are lower than the reported values for other natural fibers but comparable to the mechanical properties reported for coir fibers (10). Present paper deals with the mechanical study and the values are reported firstly for powder of phoenix sylvestries. Temperature also play a role in study of elastic constant (11), the present work has been done at room temperature 300K. Wood is an anisotropic and heterogeneous material using mechanical information to make a decision regarding its applications (12-13). Some natural fiber composites have been proven alternative to synthetic fiber. Some automobile industries like BMW, AUDI, Toyota and Mercedes-Benz have been used NF composites for making different parts of their luxuries cars. The first commercial example is the inner door panel of Mercedes-Benz, of 35% Baypreg f semi rigid (PUR) elastomer from Bayer and 65% of a blend of flax hemp (14) and sisal. This is actually evidence that NF composites are being used for environmental need and not to lower cost (15-16).

IV. FUTURE EXPECTATION

The work describe in paper was an aim to get high performing natural fiber reinforce composite and can be extended to obtain a load bearing material for aerospace automobile and industries purpose. This material can be used as filler in composites material and examined its experimental values with different polymer fibers. The experimental values of Young's modulus of PS fiber reinforced sample suggests for further research in this field Strength Properties like tensile flexure, hardness, moisture content can be examine for better industrial applicability.

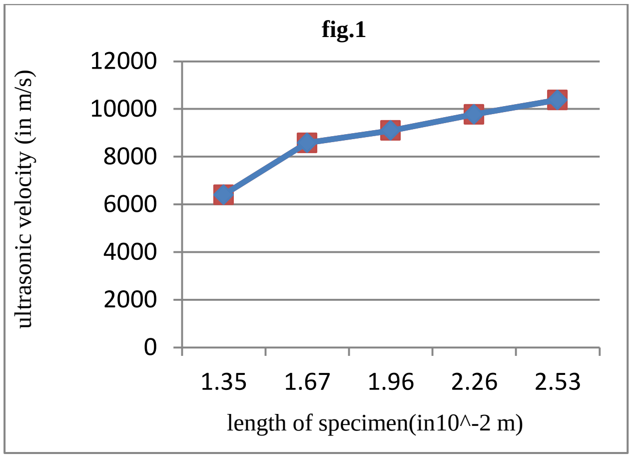
V. CONCLUSION

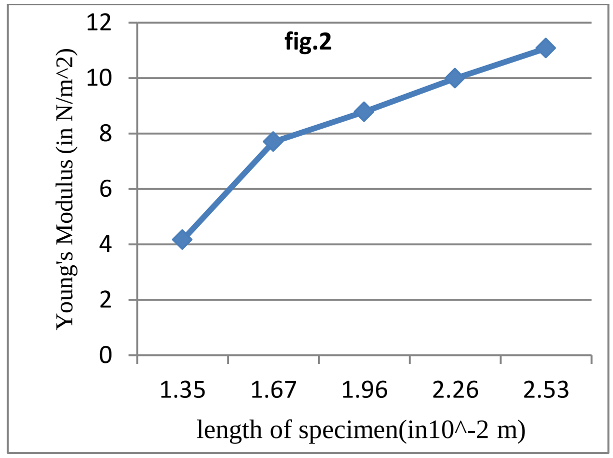
The present study has been undertaken with an objective to explore the potential of PS fiber as a composite and to study mechanical properties of NF reinforced material of PS.. In this expanding world population and with the increase in structural strengthening, PS and it's reinforce composites has appreciable strength and can be utilized as a good renewable source which is environmental friendly.

Table 1: Observed value of mass, length, volume, resonance frequency of specimen and calculated value density, longitudinal sound velocity and young's modulus (elastic constant)-

Sr. No.	Mass of specimen M_s ($\times 10^{-3}$Kg)	Length of specimen L (10^{-2}m)	Volume of the specimen V (10^{-7} m^3)	Density ρ (kg/m^3)	Resonance freq. of specimen f_s(kHz)	Longitudinal sound velocity v_l (m/s)	Young's modulus Y ($10^{10}N/m^2$)
1	0.29	1.35	2.86	1015.67	151.1	6404.039	4.165
2	0.37	1.67	3.53	1047.55	162.05	8575.927	7.704
3	0.44	1.96	4.15	1061.41	158.93	9096.481	8.783
4	0.50	2.26	4.78	1046.04	156.45	9773.721	9.992
5	0.55	2.53	5.35	1027.85	154.34	1038.9	11.080

Figure.1: Graph plotted for sound velocity and Young's modulus for different length of specimen-





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