Fiber properties

As the areca sheath fibres are initially obtained in an anhydrous state it is mainly composed of 66.08% of α-cellulose, 7.40% of hemicellulose and 19.59% of lignin [11] which mainly contributes to the bond strength. In addition, it also comprises of minor constituents such as pectic matters and fatty and waxy matters that contributes in a relatively low matter to the bond strength, it is resistive to electric discharges and can be degraded with the action of fungus and bacteria, thus making the areca sheath fibre a bio-degradable material. The properties of the fibre sheath that was obtained due to pure tensile failure have been determined. Sheath as a whole comprises of infinite number of fibres, it is evident from the results that the strength taken along the direction of the fibre will be more than the strength taken along the normal direction of the fibre. Taking the density of the sheath, the specific modulus Young's modulus and the specific strength of the sheath fibre are calculated accordingly.

Areca fiber reinforced epoxy polymer composite

In making of areca sheath reinforced epoxy composite, the volume fraction of the fiber, chemical treatment of the fiber and the curing time for the composite plays an important role. In this paper the volume fraction of fiber to composite is 75% and it is kept constant through the whole process, no chemical treatment is done to the areca sheaths and the curing time for the preparation of each individual specimen is kept constant. The composite specimen was made according to the tensile standard A iSTM D 638 in which five composites were prepared. Within every composite the angular orientation of the sheath fiber is changed with respect to the x-coordinate, within the fiber layers of the composite [12]. The Young's modulus results for various combinations of different orientation of fiber layers within a composite.

Discussion

The data from the obtained results shows that the composite which had the sheath fiber orientation 90°-90°-90° has the highest young's modulus value. Comparing the fiber orientations 90°-90°-90° and 90°-0°-90°, young's modulus value of 90°-0°-90° composite decreased because of the zero degree orientation of the fiber which was less effective in taking up the force applied on the composite. Comparing the fiber orientation 45°-90°-45° and 45°-0°- 45°, even though the inter-angular difference between the adjacent layer is 45°, the 90° orientation of the fiber sheath increased the young's modulus of the overall composite [13]. As the fiber angle approaches zero the young's modulus decreased because comparing to the individual fiber properties for the 0° oriented fiber, as the load is applied along the perpendicular direction to the fiber orientation, transverse young's modulus comes into the play with yields a lesser young's modulus value than the longitudinal one. Comparing the models 45°-0°-45° and 30°-60°-30° the young's modulus value is the least from the model 30°-60°-30°, as the majority fiber sheath angle is two layers of 30° in this case and it holds a least angular difference the orientation and the x-axis its local strength when resolved to the global strength, it's strength is much lesser when compared the 90° oriented fiber's global stress.

So it is observed from this that the angle of orientation of the reinforcing fiber plays an important role in determining the overall Young's modulus of the composite in which the global strength of the composite increased as the angular orientation with reference to the x-axis increased. As the load increased, the first failure occurred in the fiber sheath that had less fiber angle orientation with respect to the x-axis, it was followed by the corresponding fiber sheath that had minimum angle of orientation [14,15].

Conclusion

The Young's modulus and the tensile strength of hot pressed, non-chemical treated areca sheath fiber was evaluated experimentally and its specific modulus was found to be 55.5% more than that of coir and 39.79% greater than that of medium density fiber board which is a engineered wood product commonly used for domestic appliances. Composites with different orientation in the sheath fiber angle were prepared and tensile test was performed, in which it was observed that the composite that had the sheath fiber orientation as 90°-90°-90° had the highest strength and it's Young's modulus was estimated to be 1.798 GPa. The maximum elongation for the composite before the first failure of the specimen occurred was evaluated. Composite with sheath fiber orientation of 90°-90°-90° had the highest elongation of about 11.6% of its original length. As the sheath fiber angle of orientation in a composite decreased, there was a significant reduction in the young's modulus value, the extension of the total composite also reduced. Composite that had least fiber orientation witnesses less longitudinal Young's modulus and it failed easily under loading and this effect was also felt in a significant manner in the composite. The composite that had 90°-90°-90° orientation of fiber gave the advantage to withstand higher strength when the load was applied only along the longitudinal direction of the sample. If the loading is of bidirectional in nature the composite with fiber orientation 45°-90°-45° can be used as the optimum one because the 45° oriented fiber enhances the composite strength when load is applied in the inclined direction with reference to the longitudinal axis.

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