Investigation on the Mechanical and Morphological Properties of Red banana/Ramie Fiber vinyl ester composites

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Abstract.
The need of green materials for various applications is in high demand. The bio fibers play a very important position to achieve eco friendliness and cost effectiveness. The aim is to analyse the effect of hybrid mat performance. In this work banana and ramie fibers were taken into consideration, With vinyl ester composites. Three different combinations have been developed in laminating the composites at 90 degree orientation. ASTM standards were used to examine the mechanical performances of the composites. The worn out analysis have been carried out by using scanning electronic microscopy. In this work two single layer fibers of ramie and banana have been taken into account and the third composite is developed with hybridisation of red banana and ramie fibers. On comparing all the results obtained the hybrid double layer of red banana and ramie fibers possessed good results in tensile/flexural property. The impact properties of ramie fiber were marginally higher than red banana fibers.

Keywords: Red Banana Fiber, Ramie Fibers, Vinyl Ester Composite, Scanning Electronic Microscopy (SEM).

1. Introduction

Need of green resources is in high demand because of its versatile applications. It is in increasing because of its ease manufacturing and cost effectiveness. The safe of handling characteristics of such materials in functioning ambience in industries in considered being effective. The work, exploitation of such natural fibers has attracted the researchers. The natural fibers are identified based on their geographical location, cost effectiveness and eco friendly. These fiborous materials are used as an key in ingredient in various applications such as automobile, household and aero space [1-6]. These fibers are used in various forms with different orientation; It is done in random orientation, Continuous orientation and in woven form. Out of various fibers used woven fibers were identified as an attractive one due to its enhanced mechanical strengths. Various fibers are used in various applications such as reinforcements. The different parts of plants are utilised in various applications. Geographical location is considered to be vital in utilisation of fibers for composite applications. The crystalline and amorphous contents are considered to be effective in manufacturing the composites [7]. Less the amorphous content more the strength of the fiber. The various fibers with different stacking sequences
and different orientation have been tried by various researchers. Vijay [8] investigated the mechanical and morphological properties of Areca Sheath and palm leaf sheath and concluded that the areca fibers as a skin and palm as a core possessed better mechanical strengths. Sai Krishnan Et al [9] analysed the performance of bamboo and jute fibers and concluded that the bamboo at the outer layer and jut at the inner layer had better mechanical properties. Jothibasu et al. [10] deliberates the performance of areca sheath/jute/glass fiber-hybrid composites and he concluded that the hybrid glass/jute/arecasheath/jute fiber composites proved improved tensile, flexural, compression, and shear properties when compared to other composites. Chaudhary et al. [11] investigated the performance of hybrid reinforced polymeric composites. Out of all the developed composites the hybrid composites had better results. Ganesh babu Et al investigated the chemical treatment of cypress pangorei and developed in form of brake pad and he concluded that chemical treated fiber had impact on overall tribological results[12].Based on this various outcome obtained, the lack of hybrisation is observed. In this work a combination of red banana and ramie fibers were utilised in the woven form and work is carried out. Mechanical strengths of hybrid composites were studied and fractured specimen were analysed by using SEM [13-15].

2. Materials and Methods (Preparation of Composites)

Red banana and Ramie fibers in the mat form were procured from jeeva natural fibers Chennai. They were procured in the form of mat and usually grow in various Asian countries. In general banana fibers were extracted from the stem part of banana. In this work vinyl ester resin were used as a matrix and the chemical composition of the used fibers is shown in the table 1 below. Methyl Ethyl ketone peroxide and cobalt naphthaate is used in this work as a catalyst and accelerator. Compression moulding technique was used in this work. They were kept at 90 degree orientation with mold dimensions of 200x200x4 mm³. All the tests were carried out as per ASTM standards. The single fiber tests for the red banana and ramie fibers were done by using zwickroell- zwickiline material testing machine. The Three composites were developed and designated as C1-Single layer red banana fiber mat(SLRBFM), C2-Single layer ramie fiber mat(SLRFM), C3-Hybrid composites of red banana fiber and ramie fiber mat(HRBRFM).The description of composites is shown in table 1 and the images of composite in mat form is shown in figure 1 below.

Table 1. Fiber layers and Acronyms for different layers of composites

| Sl.no | Designation Of Composites | Fiber Layers | Acronyms |
|-------|--------------------------|--------------|----------|
| 1     | C1                       | Single layer red banana fiber mat | SLRBFM |
| 2     | C2                       | Single layer ramie fiber mat | SLRFM |
| 3     | C3                       | Hybrid composites of red banana fiber and ramie fiber mat | HRBRFM |
3. Results and Discussion

3.1 Tensile Properties

Tensile property for evaluated Red banana/Ramie Fiber is shown below in figure 3. Single layer mat of SLRBFM and SLRFM have been analysed. Along with this Hybrid fiber properties were also evaluated. In a single layer fiber mat orientation, tensile strength for the red banana fibers was considerable higher than that of the ramie fiber. Out of all the composites the three composites developed the hybrid composites possessed better results. It is observed that the hybrid composites possessed better results at 90 degree orientation. This is mainly attributed owing to its high stiffness property of the fiber and load transfer between the fiber and the matrix. The single fiber strength of red banana had higher strength owing to its transformation in load between the fiber and the medium. Same observations was seen in the previous literatures done before [16-18].
3.2 Flexural Properties

The Flexural Strength of the developed composites is analysed and the details are given below. Flexural specimens of red banana fiber mat composites and ramie fiber mat is analysed and it is shown in the figure 3. Single layer mat orientation reinforcements for both C1-Single layer red banana fiber mat (SLRBFM), C2-Single layer ramie fiber mat (SLRFM) was carried out at 90 degree orientation. The strength of both the composites were varied in between 28 MPa to 42 Mpa. Among all the developed composites the double layer composites with hybridisation of both red banana and ramie fibers had better results. This may be attributes due to its orientation and interfacial bonding between the fiber and the matrix. The same thing is witnessed in various literature work done before [19].

![Figure 3: Tensile and Flexural Tested Specimen of single fiber and hybrid composites](image)

3.3 Impact Strength

The Energy absorbed during machining operations is carried out with the help of impact strength. The hybrid composites at 90 degree orientation had better results. It is identified based on the results that the Single layer red banana fiber mat (SLRBFM) had less value than that of the Single layer ramie fiber mat. Out of all the
composites the Hybrid composites of red banana fiber and ramie fiber mat (HRBRFM) composites possessed better results. The enhancement in the hybrid layers is mainly due to the number of layers of mat present. The Single layer ramie fiber mat had better results due to its high energy absorption capacity. The single layer red banana fiber absorbed less strength due to which it impact strength gets decreased [20].

Figure 5: Developed Composites (Examination of Impact Strength)

Figure 6: Impact Tested Specimen Sample
4. Conclusion

In present research, Red banana fibers and Ramie fibers were fabricated and the various Properties such as tensile, Flexural and impact properties have analysed. The 90 degree orientation of the fibers enhanced the results of all the composites. Based on the various results obtained it can be concluded that the highest tensile and flexural strength is obtained for Hybrid composites of red banana fiber and ramie fiber mat (HRBRFM) at 90 degree orientation. It is mainly attributed because of its hybridisation technique between the red banana and ramie fibers. The impact strength is best for the rmie fiber mat composites because of its energy absorption capacity. Depending on these experimental results, one can easily produce low cost environment friendly high strength polymer matrix composites for automobile industry as well as domestic purpose.

5. References

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