International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 02 Issue: 03 | June-2015 www.irjet.net p-ISSN: 2395-0072

DEVELOPMENT OF PINEAPPLE LEAF FIBER REINFORCED EPOXY RESIN COMPOSITES

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Abstract *The project work is aimed at developing the pineapple leaf fiber reinforced epoxy resin composite on different fiber volume ratios of 10%, 20% and 30% .The composites are developed by using hand lay-up technique. The developed composites are used to conduct the mechanical tests like tensile test, flexural test and hardness test. The testing results are obtained. From the results the tensile strength for volume ratio 10%, 20% and 30% was obtained as 26.91MPa, 35.8MPa and 65.95MPa.Hence it can be concluded that the tensile strength increases as the volume ratio changes from 10% to 30% and maximum tensile strength was seen at 30% volume ratio. Similarly the specimens were subjected to flexural testing for volume ratio 10%, 20% and 30%.The flexural strength obtained as 38.55MPa, 58.37MPa and 121.83MPa.*

From the results it can be seen that there is a significant increase in flexural strength from 10% to 20% but drastic increase in flexural strength is seen at volume ratio 30%.the hardness of the specimen was determined using Rockwell hardness tester. The hardness for volume ratio 10% is 40B, the hardness for volume ratio 20% is 59B and the hardness for volume ratio 30% was obtained as 80B.Hence it can be concluded that among 10%, 20% and 30% volume ratio, the maximum tensile, flexural strength and hardness is seen in 30% volume ratio. From this study it is proposed that the pineapple leaf fiber reinforced epoxy resin composite serves as an alternate source for wood.

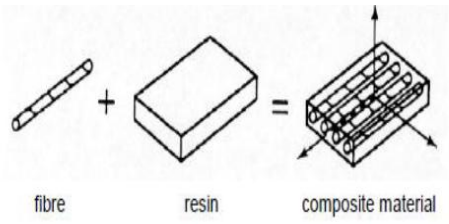
Keywords: Pineapple leaf fiber, Epoxy resin, Flexural strength, Tensile strength, Hardness.

1. INTRODUCTION

The demand for wood as a building material increasing day by day but the availability has been diminishing. Hence there is a need for the developments of alternative material .There were many alternatives which can replace the wood among which the composite were best suitable. Composite materials were materials which were formed from two or more constituent material which can provide the desirable properties and the materials can be easily separated. Composite material has two phases

Matrix phase: The matrix phase is the continuous phase in the composite. It may be a polymer, metal or ceramic. Among these polymer is consider to be best by its mechanical and thermal properties. It is low cost and easy fabrication hence it is economical.

Reinforcing phase: The reinforcing phase is the distribution phase in the composite. Many reinforcing materials were available such as the natural fiber, synthetic fiber, particle etc.



Composite materials have high mechanical properties when compared to each individual material. Composite material results in a newly material with high mechanical and thermal properties which cannot be achieved by a single material [1].

Nowadays there has been a growing interest in developing natural fiber reinforced polymer composite for low cost constructions and building applications. In many countries where the availability of natural fibers were abundant, the scientists and engineers apply suitable technologies to utilize those natural fibers economically in developing quality fiber reinforced polymer resin composite for constructing and other applications. A proper composite should have good distribution of fibers within the matrix. A good distribution means the fibers were fully isolated from each of them and they should be surrounded by polymer matrix. Hence there is a need for the development of the fiber reinforced in a polymer composite for the substitution to the scarce wood and also for the synthetic fibers [2].

2. OBJECTIVES

1. In the present work, a composite containing pineapple leaf fibres as reinforcing phase and epoxy resin as matrix phase is developed by using handlay up technique.
2. The composite specimen of volume ratio 10%,20% and 30% were prepared.
3. Then the developed specimens were subjected to tensile test, flexural test and hardness test to determine the properties.
4. The obtained values of mechanical properties of each volume ratio is tabulated and compared.
5. The optimum volume ratio for which the composite show better mechanical properties is concluded.

3. METHODOLOGY

3.1 MATERIALS

For the composite development a compression moulding is used. The pineapple leaf fiber is used as reinforcing phase and epoxy resin LY556 as matrix phase is used. A hardener HY951 is used for the composite development.

3.2 MANUFACTURING OF THE COMPOSITE

The composite specimens were prepared using hand layup technique. Initially the wax has to be applied to the mould for the easy removal of the specimen. The pineapple leaf fibres were then placed in the mould cavity and calculated amount of resin with hardner is poured in to the mould. The box is closed on which a sufficient weight is kept on the mould box and heated for an hour at 90^{o}C. Then the mould box is allowed for cooling and specimens were formed. Then the specimens were subjected to testing and tabulated.

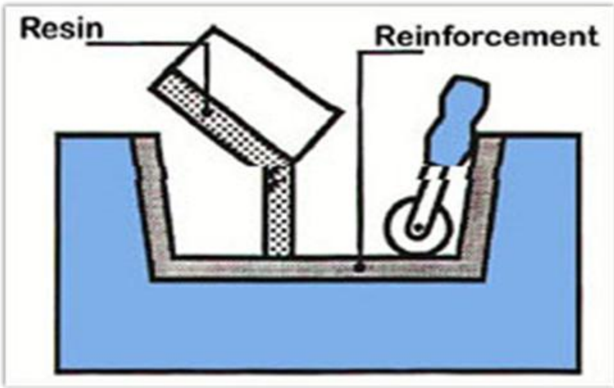


Fig 3.1 Handlay up technique

4. RESULTS AND DISCUSSION

4.1 TENSILE STRENGTH

Table4.1 Tensile test values

SAMPLE NO	VOLUME RATIO (%)	PEAK LOAD (N)	TENSILE STRENGTH (MPa)
1	10	1615.00	26.91
2	20	2147.70	35.8
3	30	3957.00	65.95

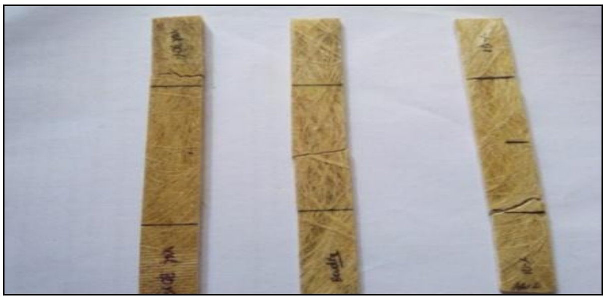


Fig 4.1 Tensile tested specimens

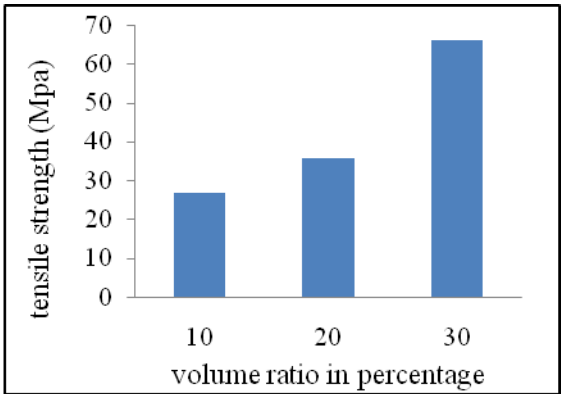


Fig 4.2 Influence of volume ratio on tensile strength of the specimen

- The influence volume ratio on the tensile strength of the specimen was determined.
- The tensile strength for the volume ratio 10% was obtained as 26.91MPa and the tensile strength value increased for volume ratio 20% as 35.8MPa. The tensile strength value increased significantly for 30% as 65.95 MPa when compared to the 10% and 20% volume ratio.
- Hence maximum tensile strength is obtained at volume ratio 30% when compared to the specimens of volume ratio 10% and volume ratio 20%.

4.2 FLEXURAL STRENGTH

Table 4.2 Flexural test values

SAMPLE NO	VOLUME RATIO (%)	PEAK LOAD (N)	FLEXURAL STRENGTH (MPa)
1	10	58.0	38.55
2	20	88.0	58.37
3	30	183.0	121.83

Fig 4.3 Flexural tested specimens

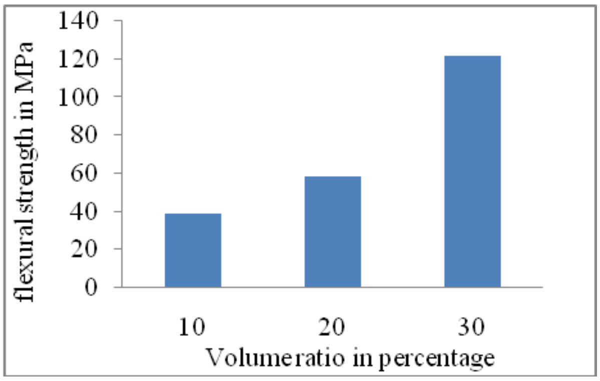
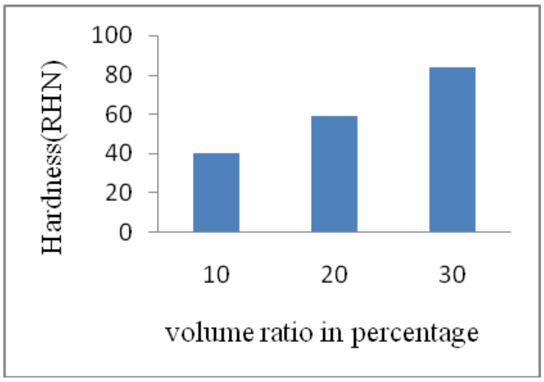


Fig 4.4 influence of volume ratio on flexural strength of the specimen

- The influence volume ratio on the flexural strength of the specimen at volume ratio 10%, 20% and 30% was determined.
- The flexural strength for the volume ratio 10% was obtained as 38.55MPa and the flexural strength value increased for volume ratio 20% as 58.37MPa. The tensile strength value increased significantly for 30% as 121.83 MPa when compared to the 10% and 20% volume ratio.
- Hence maximum flexural strength is obtained at volume ratio 30% when compared to the specimens of volume ratio 10% and volume ratio 20%.

4.3 HARDNESS TEST

Table 4.3 Hardness test values



SLNO	VOLUME RATIO (%)	LOAD (Kg)	RHN
1	10	100	40B
2	20		59B
3	30		84B

Fig 4.5 Influence of volume ratio on hardness of the specimen

- The hardness for the specimens of volume ratio 10%, 20% and 30% was determined. The hardness for volume ratio 10% specimen was obtained as 40B and the hardness for volume ratio 20% was obtained as 59B. The maximum hardness was obtained at volume ratio 30% as 84B. Hence the hardness increased as the volume ratio increased up to volume ratio 30%.

5. CONCLUSION AND SCOPE FOR FUTURE WORK

5.1 CONCLUSION

- The tensile strength of the specimens at volume ratio 10%, 20% and 30% was determined and it was shown that the maximum tensile strength was obtained at volume ratio 30% when compared to 10%, 20% volume ratio. Hence volume ratio 30% has maximum tensile strength.
- The flexural test was conducted for the specimen of volume ratio 10%, 20% and 30%. From the test it was obtained that the flexural strength significantly increased as the volume ratio increased from 10% to 30%.the maximum value of flexural strength was obtained at 30%.
- Similarly specimen of volume ratio 30% had the maximum Rockwell hardness number when compared to the specimens of 20% and 10% volume ratio.

5.2 SCOPE FOR FUTURE WORK

- Other natural fibers can be used with the pine apple leaf fiber to develop a hybrid composite and thereby its mechanical properties can be determined.
- The mechanical properties of the composite also depends on the factors like the fiber orientation, fiber length etc. Hence a composite with varying following factors can be developed and mechanical properties can be determined.
- The pineapple leaf fiber reinforced epoxy resin composite of volume ratio more than 30% can be developed and its mechanical properties such as tensile strength, flexural strength and hardness can be determined and compared.
- A Filler material can be used in the composite for better improvement of mechanical properties.

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