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Study of Natural Fibre Reinforced Vinyl Ester Composite

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Abstract—*In the present scenario, environmental regulations and societal concern are forcing the industries to explore new and eco-friendly materials that can replace non-degradable materials for a clean and green environment. Hence, natural fibres are utilized for the preparation of polymeric composites. Polymer composites based on natural fibres are developed by replacing synthetic fibres for applications in automotive and electronic fields. This study is aimed at investigating the chemical properties of vinyl ester resin reinforced with natural fibres along with a combination of coupling agents that will help to increase the flexibility of the matrix.*

1. INTRODUCTION

Composites, plastics and ceramics are the main material that is being used by the present world. Composites have a more significant advantage because these are made by engineering processes and mainly helpful to reduce the weight and hence to increase the efficiency. Composite material consists of two or more materials in a different phase. The depletion of petroleum resources, plastic disposal problems and emission during incineration along with increasing environment regulations has led to increased interest in development of green-composite materials that are compatible with environment and independent of fossil fuels.[1-4], Plastics can be made more bio-degradable by reinforcing them with natural fibres.

One such fibre is bagasse fibre which is easily available since it is a by-product obtained from sugar production. Among various natural fibers, bagasse is considered as one of the most potential reinforcement for polymer composites due to its many advantages such as its easy availability, its low production cost and satisfactory mechanical properties as compared to others fibers.

2. EXPERIMENTAL PROCEDURE

2.1 Materials

General purpose vinyl–ester resin from Yash Composite Solutions, Ghaziabad, was used in this study. The resin is a mixture of styrene with a methacrylated epoxy compound, which is also referred to as vinyl– ester (VE). Along with it, Benzoyl Peroxide, Cobalt Octate and PMMA acid were used as catalyst, accelerator and initiator.

The bagasse fibers were extracted using the conventional manual method in K.R. Pulp and Paper Ltd., but the resulting fibers are shorter. It can be obtained from different parts of the sugarcane stalk comprising the outside rind crushed with the inner pith.

The fibres were dried in an oven at 100°C for 2 hours and then crushed in a grinder to get uniformity in their size and texture.

2.2 FABRICATION OF COMPOSITE

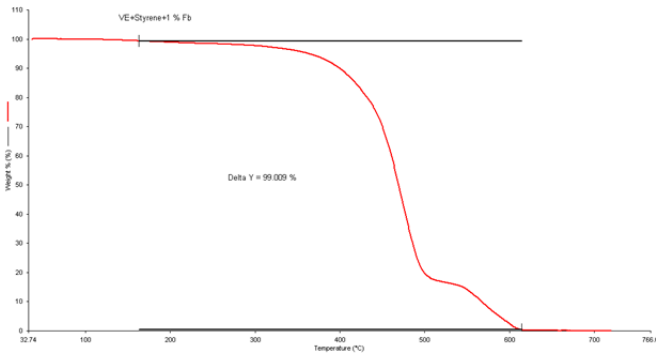
Resin was mixed with accelerator and promoter in a ratio of 100:1:0.5 and was mixed vigorously for 30 minutes followed by mixing of 20% PMMA acid. Pre-dried bagasse fibre was then homogeneously mixed in the accelerated mixture in the ratios 1%,3%,5% and 7%. The four compositions were then placed in the mould and kept for curing at room temperature in a compression moulding machine at a pressure of 2000kg-f for 48 hours.

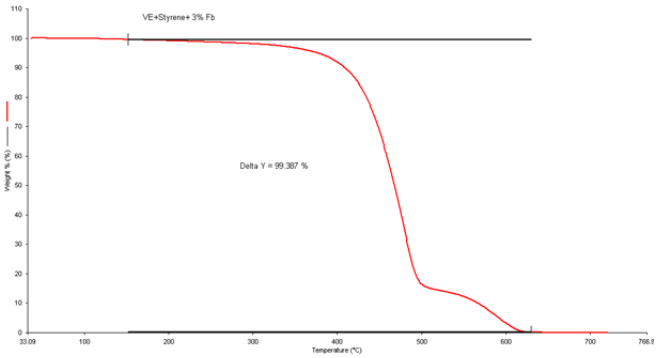
3. TESTING OF COMPOSITES

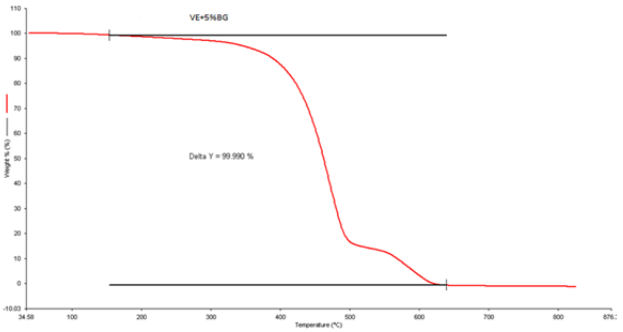
All the four composites were analyzed for their thermal stability by using thermo-gravimetric analysis (TGA), according to ASTM D3418 using heating rate 10°C/min and graph was plotted in terms of residual weight v/s temperature. The percentage weight loss was calculated.

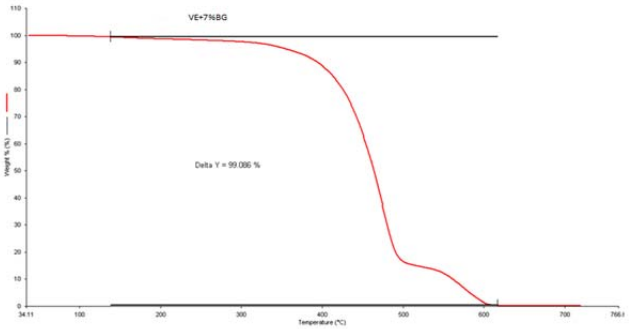
4. RESULTS-

4.1 TGA



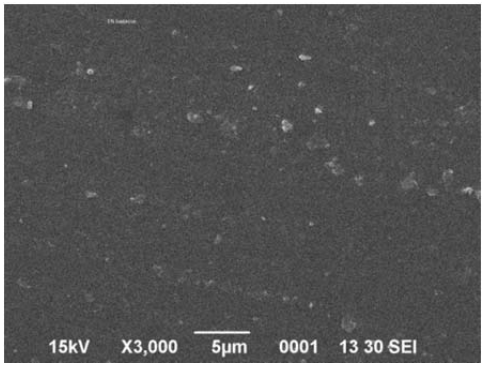




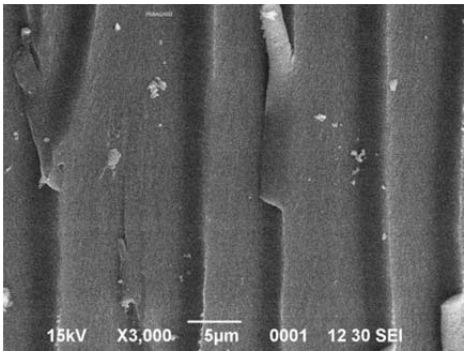


4.2 SEM Analysis- At 3000 magnification:

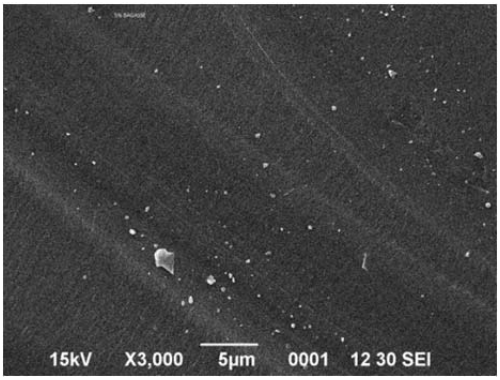
1% bagasse fibre-



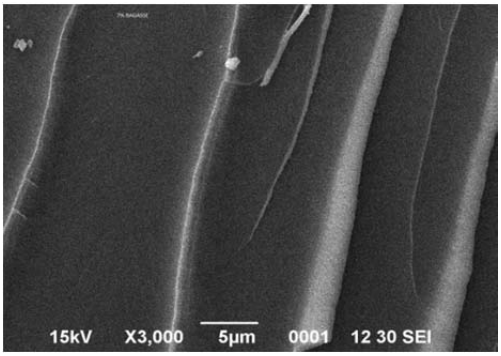
3% bagasse fibre-



5% bagasse fibre-



7% bagasse fibre-



5. DISCUSSION AND CONCLUSION

Analysing all the graphs we observe that,-

1) For temperature range 400-500°C,

Table 1.

COMPOSITION	%DEGRADATION
1%fibre	74%
3%fibre	79%
5%fibre	77%
7%fibre	73%

2) For temperature range 500°C upto final decomposition,

Table 1.

COMPOSITION	%DEGRADATION
1%fibre	17.85%
3%fibre	12.13%
5%fibre	11.63%
7%fibre	14.38%

Therefore, we can say that for temperature range of 400-500°C, bagasse fibre concentration of 7% is most stable thermally. However, above 500°C, it is seen that 5%concentration is most stable thermally.

As far as environmental factors are considered, 3% fibres concentration degrades most below 500°C and 1% fibre concentration degrades most above 500°C. These figures can further be optimized to get the best combination of thermal stability as well as optimal decomposition for reducing plastic waste. This composite can be used for a wide range of applications such as buildings, automotive, household appliances and other applications.

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