Chapter 6

Conclusions and Scope for Future Work
CHAPTER 6

CONCLUSIONS AND SCOPE FOR FUTURE WORK

This chapter contains the summary of the outcome of the work carried out for the surface modification & characterization of banana fiber, characterization of Euphorbia latex and development of composites and their characterization. This chapter also contains the scope for the future work.

6.1 INTRODUCTION

Composites comprise of two materials binder and reinforcing agent. The binder act as stress distributor and reinforcing agent as the load bearer, and used for structural and load bearing applications due to their high strength. Presently, in the available composites both the binder and the reinforcing fibers are synthetic or either one of the material is natural and other one is synthetic. Presently natural fibers are used in the composites preparation along with the polymeric material to overcome the problem associated with global petroleum feedstock and voluminous waste generated after disposal of the composites material. Natural fiber used in composites gets biodegrade after use when disposed to the environment but the polymeric materials used as matrix in preparation of these composites are generally durable and remains as such for long-time after disposal. So emphasis of environmental pollution problems and land-shortage problem for solid waste management, such as non availability of landfills, public perception, and reduction of fertility of lands due to the accumulation of surface litter, the use of environmentally degradable and ‘environmentally friendly’ polymers in the preparation of
composites are become the area of interest for researchers. Use of plant based natural resin, as matrix in the composites preparation will reduce the waste accumulation after disposal. Further, utilization of natural fiber and natural resin especially plant based resin will provide incentive to petroleum based products.

In the present study we had developed composites using both the materials, coagulum as the matrix and banana fiber as the reinforcing agents derived from natural source i.e. natural material. The results obtained are concluded in this chapter.

6.2 CONCLUSIONS

a) Surface modification of the banana fiber was carried out by alkali treatment and characterized. From the result it was observed that

- Alkali treatment of fiber removes the impurities and lignin present on the surface of the fiber
- The surface roughness of the fiber increases.

b) Euphorbia latex was coagulated and the coagulum was characterized for the chemical composition, chemical properties, thermal behavior and functional groups. From the result it was observed that

- It has sufficient amount of unsaturation, which will help in the crosslinking of the coagulum during preparation of composites,
- Its initial degradation temperature is around 190°C and 50% degradation takes place at around 350°C, shows that it will
withstand the processing condition used in the processing of composites.

c) The Euphorbia coagulum banana fiber composites were prepared by varying fibers content and characterized for physico-mechanical, and morphological properties. Results show that banana fiber composites having 50 wt % of fiber has best physico-mechanical property. From the result it was observed that

- The water absorption of composites increases with increasing the fiber content, which is quite obvious because of the presence of hydroxyl and other polar groups in the banana fibers

- The mechanical properties of composites was found optimum for 50 wt % of fiber further increase in fiber content results in decrease of the mechanical properties due to an agglomeration effect of fiber at higher weight loading results in poor dispersion of the fibers in polymer matrix leading to non-uniform transmission of the applied stress from the matrix to fiber

d) The Euphorbia coagulum banana fiber composites were also prepared by varying the length of fibers and characterized for physico-mechanical, and morphological properties. Results show that banana fiber composites having fiber length 4mm has best physico-mechanical property. From the result it was observed that

- With increasing the length of fiber the water absorption increases because with the increase of fiber length, the fiber get agglomerate
leading to the formation of voids which provide sites for penetration of water in the composites.

- The composites having fiber with 4mm length possess best flexural properties due to two reasons: the existence of defects (such as voids) as well as weak interface bonding between matrix and long fiber which leads to poor matrix/fiber adhesion.

e) Surface treatment of banana fibers with sodium hydroxide results in the remarkable improvement in the physico-mechanical properties of the composites due to the better adhesion of the resin with the fiber surface.

f) Polyester banana fiber composites were modified by replacing polyester resin with varying amount of Euphorbia coagulum and characterized for physico-mechanical, thermal, flammability and morphological properties. It was noticed that the

- Water absorption of the composites decreases with increasing the coagulum content in unsaturated polyester resin. This is due to the filling of the gaps, between the matrix and fiber created after shrinkage of the polyester resin, by Euphorbia coagulum. This gap facilitates the penetration of the water molecules in the composites leading to increase in water absorption.

- With the increase of the coagulum content, impact strength of the composites increases due to the presence of rubber in the Euphorbia coagulum, which acts as impact modifier for the unsaturated polyester resin.
Replacement of 40% polyester resin with Euphorbia coagulum in composites gives best results for flexural properties and further increase in coagulum content results in the deterioration in the properties. The flexural property of composites increases initially due to the filling of the gaps, between the matrix and fiber created after shrinkage of the polyester resin, by Euphorbia coagulum, because this gap acts as the crack propagation point. The decrease in the properties beyond 40% of coagulum is due to the plasticization effect of the rubber present in the coagulum.

With increasing the coagulum content limiting oxygen index of composites increases due to the presence of protein in the Euphorbia coagulum, which act as a source of nitrogen.

The smoke density rating of the composites decreases with increasing coagulum content, because with the replacement of polyester resin the aromatic carbon present in the polyester also replaced which are responsible for the generation of smoke during burning of the polyester resin banana fiber composites.

The microbial growth of the Euphorbia coagulum modified polyester composites was carried out which shows that due to the presence of coagulum in coagulum modified composites the growth of the A. nigar was found on the cut as well as skin surface where as in case of polyester composites the growth was only on the cut surface where banana fiber is exposed because polyester resin resists the
growth of A. nigar. This shows that developed Euphorbia coagulum-polyester-banana fiber composites will get degraded when exposed to the land filling sites.

g) The bio-degradability study of the optimized compositions of Euphorbia coagulum banana fiber and Euphorbia coagulum modified polyester banana fiber composites were carried out as per ASTM D 5338. The result shows that the bio-degradability of the Euphorbia coagulum banana fiber and Euphorbia coagulum modified polyester banana fiber composites are around 70% and 40% respectively within the test duration 90 days in comparison to the reference material i.e. cellulose which degrades around 90% within same duration.

6.3 FINAL COMMENTS

The Euphorbia coagulum banana fiber composites containing 50% fiber of length 4mm possess best physico-mechanical properties whereas Euphorbia coagulum modified unsaturated polyester resin composites containing 40% coagulum possess best properties will get bio-degrade when exposed to the land fill sites.

The prepared natural fiber composites could be utilized to replace wood in making partition panels for house & industries, roof of village huts, bullock carts, etc. This study would provide an opportunity of replacing petroleum based derivatives, i.e., petroleum based polymeric material by Euphorbia latex for the preparation of natural fiber composites. This will also provide job
opportunity to villagers in cultivation and collection of latex from these plants and will help them in setting up small-scale industries in villages.

6.4 SCOPE FOR FUTURE WORK

- The composites can be developed by using other fibers such as hemp, flex, bamboo, etc. along with coagulum from the latex of Euphorbia royleana.

- Various other surface modification techniques for the modification of surface of natural fibers can used to get composites with improved physic-mechanical properties.

- Latex from other species of Euphorbia viz. Euphorbia *nerifolia*, *Euphorbia nivulia*, etc can use for the preparation of composites.

- Latex of other latex bearing plants from various families viz. Apocynaceae, Euphorbiaceae, Asclepiadaceae can be used for the preparation of composites.