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FABRICATION AND CHARACTERIZATION OF NATURAL FIBER REINFORCED HYBRID COMPOSITE MATERIALS

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ABSTRACT

The present and future sight of commercial material are focusing on composite material due to its light weight and versatility. At the same time the composite must be ecofriendly, so that it degrades easily. Green fibers are emerging as less cost and its production has lower environmental impacts because of its biodegradable characteristics. Hence the natural fiber reinforced natural resin matrix composite is suggested for the same. The aim of this paper is to produce Green composite material, where both fiber and matrix are from the natural source. Cashew nut shell resin and synthetic resin as matrix and banana fibers, jute fibers are used and its characteristics are studied. Several fabrication methods were tried to incorporate them in polymeric, natural reinforcement and characterization of these new composites, factors affecting to the environmental conditions are reported. Complication arising out during the processing of green composites and attempts made to minimize these difficulties are also described. Efforts to fabricate a new green composites and assessing their performance in practical application are presented. In future this work will be extended by analyzing its various mechanical properties.

Key words: Natural fiber, Hybrid composite, Cashew Nut Shell Resin (CNSL), banana fiber

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1. INTRODUCTION

Composite materials consist of different constituents with two or more chemicals having distinct properties. One or more discontinuous phases is fixed in a continuous phase to obtain composite, the discontinuous phase is harder and stronger when compared to the continuous phase. The fibre from the natural source are low cost, low density and have high specific properties when compared to the synthetic. Considering global environmental and social

concern, high rate of decline for novel environmental policy has enforced the research for composite materials reinforced with naturally available fibre, attuned with the environment. For recent years, the use of naturally available fibre as reinforcement in composite material for engineering applications has been increased enormously, reinforcement is one of the phase in composite material which increases the strength of the material, helping to support structural load. The organic or in organic materials(usually called as matrix or binders) maintains the orientation and position of the reinforcement .

Composite materials are hybrid materials which is made up of a polymer resin reinforced by fibers, combining the high mechanical and physical properties of the fibers and the appearance, bonding together and increasing the physical characteristics of polymers. The important parameters of bio-degradable polymers are synthetic and natural, which are produced from feedstock derived non renewable resources or from biological resources (renewable resources). The strategy discussed in this report aims to add value to the crops by processing the fibers into so called natural fiber composites. Challenging factors towards biodegradable polymers are increasing day by day due to several concerns on managing carbon emissions in a sustainable manner.

For past decades, extensive research work have been carried out on the natural fiber reinforced composite materials in many engineering applications. Natural fibers are available in abundance in nature and can be used to reinforce polymers to obtain light and strong materials. Natural fibers from plants are beginning to find their way into commercial applications such as automotive industries, household applications, etc. [9]. Short banana fiber reinforced polyester composite was studied by Pothan et al. [2], the study concentrated on the effect of fiber length and fiber content. The maximum tensile strength was observed at 30 mm fiber length while maximum impact strength was observed at 40 mm fiber length.

Information on the usage of banana fibers in reinforcing polymers is limited in the literature. In dynamic mechanical analysis, Laly et al. [10] have investigated banana fiber reinforced polyester composites and found that the optimum content of banana fiber is 40%.

The banana fiber have beenused in this present work which is received from verkilambi(southern part of Tamil Nadu) near Kaniyakumari, India. And cashew nut shell liquid is used as a one of the matrix material which is received from Panurti, Tamil Nadu, India. Apart from banana fiber, jute fiber also used as reinforcement with CNSL resin to study the bonding nature between the constituents.

2. EXPERIMENTAL PROCEDURE

Hand lay-up technique is the oldest and common technique for fabrication of fibers reinforced polymer composite materials. This is due to the good mechanical properties specifically the fatigue properties that can be obtained by this method. However, according to the best knowledge of this paper, no research was reported about the fabrication of jute fibers polymeric composites via the hand lay-up method. The entrapped air bubbles are too difficult to be removed from the jute mat during the conventional hand lay-up technique, because the jute mat is usually thick and incoherent.

2.1. Preparation of Resin with different Compositions

1. Taking 25 ml of phenol in a beaker, then add50ml of formaldehyde, 5gm of sodium hydroxide pallets, then heating this mixture in a heating mantle at 40°C and stir it for about 5-10min. after 10mins add 40 ml of CNSL with this mixture and increase the temperature about 50 C and then stir it again for about 20 minutes. Kept it for 2-3 days for curing purpose.

2. Taking 25 ml of phenol in a beaker and adding 50ml of formaldehyde, 5gm of sodium hydroxide pallets, then heating this mixture in a heating mantle at 40°C and stir it for about 5-10min. after 10mins add 40 ml of CNSL with this mixture and increase the temperature about 50 C and after 10 min of adding CNSL mix 10g of zinc oxide to it, then stir it again for about 15 minutes. Kept it for 2-3 days for curing purpose

3. Taking 20g of urea & 50ml water in a beaker then add 50ml of formaldehyde, 5gm of sodium hydroxide pallets, then heating this mixture in a heating mantle at 40°C and stir it for about 5-10min. after 10mins add 40 ml of CNSL with this mixture and increase the temperature about 50 C and then stir it again for about 20 minutes. Kept it for 2-3 days for curing purpose

Formation of GP resin

Take 50ml of GP resin, then add 10ml accelerator, 5ml of catalyst and stir it.

Blending of natural resin with synthetic resin:

Take 50ml of GP resin, then add 50ml CNSL resin, 10ml accelerator, 5ml of catalyst

Fiber treatment

Banana fiber and jute fiber is treated with sodium hydroxide in 10liters of water separately. Kept it 24 hour and dry it under natural source.

2.2. Composite Manufacturing Methods

2.2.1. Banana fiber and synthetic resin

Composites were made using a Teflon mold measuring 150mm x 150mm x 40mm length, width and depth, respectively. A releasing agent was sprayed onto a laboratory tissue and smeared evenly onto the surface of the mould. Resin was poured onto each layer of fibre in a random configuration to ensure even delivery of the resin and the procedure was repeated for each layer of fibre. The layers of the wetted fibres in the mould were then placed at room temperature for 24hrs.

2.2.2. Jute fiber and Synthetic resin

Composites were made using a Teflon mould measuring 150mm x 150mm x 40mm length, width and depth, respectively. A releasing agent was sprayed onto a laboratory tissue and smeared evenly onto the surface of the mould. Resin was poured onto each layer of fibre in a random configuration to ensure even delivery of the resin and the procedure was repeated for each layer of fibre. The layers of the wetted fibres in the mould were then placed at room temperature for 24hrs.

2.2.3. Composite with natural fiber and hybrid resin

Composites were made using a Teflon mould measuring 150mmX150mmX40mm length, width and depth, respectively. A releasing agent was sprayed onto a laboratory tissue and smeared evenly onto the surface of the mould. Resin was poured onto each layer of fibre in a random configuration to ensure even delivery of the resin and the procedure was repeated for each layer of fibre. The layers of the wetted fibres in the mould were then placed at room temperature for 24hrs.

3. RESULT AND DISCUSSION

Hybrid composite materials were made manually by hand lay-up technique. The materials madewere interpreted in terms of variation in the physical properties.

3.1. Banana Fiber with Synthetic Resin

Due to chemical constituent variation among similar types or different types of natural fiber, optimal treatments like NaOH concentration, time and temperature will vary the physical

nature of each material. The below figures shows, imperfection in physical nature of the material is varying based on the reinforcement used.

Figure 1 Composite with banana fiber and synthetic resin

3.2. Jute Fiber with Synthetic Resin

Figure 2 Composite with jute fiber and synthetic resin

After fabrication process the synthetic resin with banana fiber resulted in a good form for making composites process of curing takes place quickly for around 5-6hrs and as well as for jute fiber. But when compared with blended resin (CNSL+synthetic resin) the curing process takes around 24hrs to 36hrs. The composite material so obtained from blended resin is like some form of rubber material.

3.3. Composite with Natural Fiber and Hybrid Resin

Figure 3 Composite with jute, banana fiber and blended resin

3.4. CNSL with Formaldehyde

CNSL resin formation with zinc oxide, urea, phenol and without zinc oxide so obtained has taking more curing time when compared to other resins, it takes around 25days to 30days.

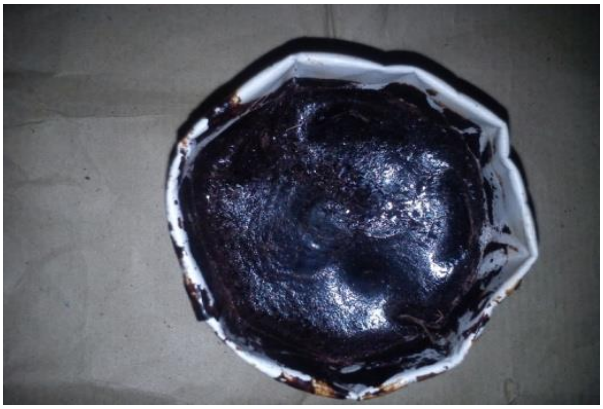

Figure 4 CNSL resin for composite

4. CONCLUSIONS

However, none of the interpretations in all the above studies is supported by structural or other evidence. Further, performance of these boards in actual use or when subjected to accelerated weathering tests has not been determined in any of these studies, this would have helped in assessing these composites for long-term stability. Also, cost factors have not been considered.

The following conclusions are based on the findings reported in this paper:

- After fabricating the different composition of composite we conclude that synthetic resin with natural fiber is suitable for many application
- Attempts should be made to minimize the resin consumption and moisture absorption by the natural fibers through simple and economic processes, keeping in mind the establishment of this fiber industry in rural and semi-urban areas.
- Suitable inexpensive resins should be developed for better performance and better compatibility with natural fibers. Some attempts in this direction are being made.
- The banana fiber composite exhibits a ductile appearance with minimum plastic deformatiom.

Studying and covering all these aspects will go a long way in fulfilling the search for new materials which have comparable properties to substitute for conventional materials in various applications.

REFERENCES

[1] N.ABILASH, M.SIVAPRAGASH "Environmental benefits of ecofriendly Natural fiber reinforced Polymeric composite materials", Faculty,2Research Director, Department of Mechanical Engineering, Noorul Islam University, Thuckalay-629180, Tamilnadu, India, ISSN 2319 – 4847, Jan 2013.

[2] L. A. Pothan, T. Sabu, and Neelakantan: "Short Banana Fiber Reinforced Polyester Composites: Mechanical, Failure and Aging Characteristics", J. Reinforced Plastics and Composites, 16(8)(1997), pp. 744–765.

[3] Jeong-Hun Lee, Jisoo Jeon, Sumin Kim Green Adhesives Using Tannin and Cashew Nut Shell Liquid for Environment-friendly Furniture Materials", School of Architecture, Soongsil University, Seoul 156-743, Korea

[4] Sharifah H. Aziz, Martin P. Ansell: The effect of alkalization and fibre alignment on the mechanical and thermal properties of kenaf and hemp bastfibre composites: part 2 – cashew nut shell liquid matrix", Department of Engineering and Applied Science, University of Bath, Bath BA2 7AY, UK, Received 20 May 2003.

[5] Wei-ming Wang et.al;: Study on the Chemical Modification Process of Jute Fiber, Journal of Engineered Fibers and Fabrics,Volume 3, Issue 2, 2008.

[6] Pillai C, Anthony R.: GPC studies on the cationic polymerization of cardanol initiated by borontrifluoridediethyletherate. J ApplPolymSci 1990;41:1765–75.

[7] Medina L et.al: Process related mechanical properties of press moulded natural fibre reinforced polymers, Composites Science and Technology 69 (2009) 1404-1411.

[8] Saha A, Das S, Bhatta D, Mitra B.: Study of jute fibre reinforced polyester composites by dynamic mechanical analysis. J ApplPolymSci 1999;71:1505–13.

[9] F. T. Wallenberger and N. Weston: "Natural Fibers, Plastics and Composites Natural", Materials Source Book from C.H.I.P.S. Texas, 2004.

[10] T. Corbière-Nicollier, B. G. Laban, L. Lundquist, Y. Leterrier, J. -A. E. Månson, and O. Jolliet, "Life Cycle Assessment of Biofibers Replacing Glass Fibers as Reinforcement in Plastics", Resources, Conservation and Recycling, 33(4)(2001), pp. 267–287.

[11] http://i-cias.com/e.o/sumer.htm

[12] A. Lakshumu Naidu, V. Jagadeesh and M V A Raju Bahubalendruni, A Review on Chemical and Physical Properties of Natural Fiber Reinforced Composites . International Journal of Advanced Research in Engineering and Technology, 8(1), 2017, pp 56 –68.

[13] A Review on Fiber Reinforced Concrete, Grija.S, Sha nthini.D, Abinaya.S. International Journal of Civil Engineering and Technology, 7(6), 2016, pp.386–392.

[14] Dr. M. TamilSelvi, D. Yuvaraj, Dr. A. K. Dasarathy, S. Ponkumarelango and R. Subalakshmi, Assessment of Energy Absorption of Steel, Polypropylene and Hybrid Fiber Reinforced Concrete Prisms Using-Graph Software, International Journal of Civil Engineering and Technology, 8(10), 2017, pp. 1269–1276.