A Review of Natural Fibre Reinforced Composites

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Abstract: Due to the availability of natural fibre, low cost and ease of manufacturing have urged the attention of researchers to work towards the possibility reinforcement of natural fibre so as to improve their mechanical properties and study the extent to which they satisfy the required specifications of good reinforced polymer composite for industrial and structural applications in the near future. This review paper basically introduces what composites are, related to natural fibre reinforced composites along with their mechanical properties.

Keywords: Natural Fibre, Mechanical Properties, reinforcement, Composites

1. Introduction

Fibre Reinforced Composites has been using by different people since ancient times. Due to the disadvantages of normal synthetic fibres, FRC's i.e. fibre Reinforced Composites comes into account and hence many young scientists get motivated for further research work in the field of NFRC's (**Natural fibre reinforced Composites**). Now a day, we are using variety of natural fibres as reinforcement [1] in composites. Due to advancement in the field of science and technology, new techniques has been developed to characterised the mechanical properties of different composites and utilising those composites for further use. Some of the common natural fibres include Jute, sisal, banana, rice husk, elephant grass; etc. has been taken for the study of the mechanical [2] properties. The most important advantage of natural fibres is that they are renewable. This review examines the different types of fibre available and the present status of research on natural **fibre reinforced composites.** Different references of latest work on NFRC's, their mechanical properties and their processing have been included in this review paper.

Composites are those materials which comprises of strong material which can sustain very large load which is known as Reinforcement, imposed in weak material which we called as matrix. In simple word, we can say that a matrix is a base on which

a strong material is imposed on it. Matrix plays an important role in maintaining the position and orientation of the reinforcement. In this review paper, basically the concepts related to natural fibres reinforced Composites has been discussed. Natural fibre [3] has been divided into animal fibres and plant cellulose fibres. Further the plants which produce natural fibres are classified into primary and secondary fibres. In general, Composites with high mechanical strength and stiffness are developed from Plant fibres.

2. Methodology

Basically, my term paper is completely theoretical. I have collected the material of the research paper from internet websites like Wikipedia, meritnation.com, Research Gate Science direct, etc. Some books on Material Science Also, I read some material from research papers on Natural fibre Reinforced Composites previously done by several Researchers. The methods which I have done in my term papers are – completely giving the overview of topic, about its present and future scope, its advantages and finally finding the conclusions related to NFRCs. By doing so, it helps me to gain a lot of knowledge regarding the behaviour of NFRCs.

3. Types of Composites

Composites can be classified on the nature of the matrix. Fabrication process is also done in accordance with the physical and chemical properties of the matrix and the reinforcing fibres.

a) Polymer Matrix Composites:

PMCs are most common composites now a day. These types of composites consist of a thermoplastic polymer. They are low in cost, have high strength and can be manufactured through simple process.

b) Metal Matric Composites:

The name itself conveys that is consists of a metal matric. Some of the metal matrix is magnesium, aluminium and titanium. By using this type of composites, elastic stiffness and strength of material can be increased.

c) Carbon - Carbon Composites:

In this type of composites, carbon fibres are used. Carbon- Carbon Composites are used in a very high temperature range. They are 20 times stronger than other composites. Basically, thermosetting Plastics have been used to developed Natural fibres Reinforced Composites.

Some of the natural fibres include jute, sisal, banana etc. Thermosets are hard in nature and a cross linked material that doesn't get soften when heated.

These are some the topics which i have studied during the 1st week of NTCC as a review paper I, which contains the basics of composites. Further some other details regarding the natural fibre reinforced composites have been discussed below.

4. Classification of Natural Fibre

Natural fibres are classified into two main categories. They are as follows:

- Animal Fibres
- Plant Fibres
  Further the plant fibres are classified into two types. They are:
- Primary plant fibres i.e. from plant which are grown for fibres &
- Secondary plant fibres i.e. from the waste product of plant

Fundamentally, there are six kinds of plant strands named as; bast fibre [10] (flax, hemp kenaf, jute, and so on.), leaf fibre (sisal, banana), organic product fibre (cotton, coir), grass fibre (bamboo, Indian grass), straw fibre (corn, rice) and other like wood mash and roots.

In co- relation with my first review paper, which includes the basic knowledge about what composite materials are, how they are formed, and their constituents materials. In my paper, different types of composites materials also have been discussed along with their importance and how they are implemented on natural fibre reinforced composites. After reviewing my 1st paper, several conclusions are found regarding Natural fibre Reinforced Composites. Further; it insists me more to study more about NFRCs which have been discussed below.

Various properties of natural fibre reinforced composites especially mechanical properties have been discussed. Along with this, their manufacturing process has also been discussed in this review paper. This paper also includes the advantages of Natural Fibre Reinforced Composites over synthetic fibres.

As we know that the application of composites has been increased due to the development of new fibres people are manufacturing different type of composites according to their needs. Out of all the composites natural fibre reinforced composites attains a great importance because it is more advantageous than synthetic fibre those which we are using in day to day life. After reading several research papers, I came to know about the benefits of NFRCs. A concise information regarding the advantages of NFRCs has been discuss below-

The use of natural fibre reinforced composites attains a great importance in both academic as well as industry sector. Now a day, different types of natural fibres have been found for the use in plastics which includes flax, jute straw, rice husk, sisal etc.

My observation after reviewing several papers:

- I found that natural fibre reinforced composites are friendly to the environment; along with this they are totally biodegradable.
- They are available in a large quantity than other synthetic fibres.
- According to the various research, natural fibre reinforced composites are also renewable i.e., they can be renewed.
- They are cheap as they are directly extracted from the nature.
- Now a day, a number of components of automotive sector replaces glass fibre composites with environmentally friendly composites.
- They are also used in non-structural applications.

5. Mechanical Properties

In the recent years, the importances of natural fibre composites are increasing due to its better mechanical performance significantly. This improvement is basically due to improved fibre selection, better extraction process, as well as better composite processing. They have low density and high thermal insulation as they are extracted from nature. Along with this they are resistance to corrosion. Sanjay.R [4] studied on the mechanical properties of sisal and glass fibre reinforced composites to compare the properties like tensile strength, impact and flexural strength. They found that sisal being a natural fibre than glass fibre has more high tensile strength and high flexural strength. Singha A. [5] has done a scanning using electron microscope on a natural fibre called Hibiscus sabdariffa. They also concluded that the fibre as a good scope in the fabrication of natural fibre reinforced composites, having a large number of industrial applications.

In a study regarding banana fibre by J.Santosh [6] used NaOH to increase the wettability of natural Fibre Reinforced composites. They concluded that when we treat a natural fibre with any alkali , they increases the wettability of the fibre and this helps to increase the mechanical properties like tensile strength , flexural strength etc.

6. Thermal Properties

Due to increase in rapid consumption of fossil fuel and due to that problems like global warming and environmental issues are increasing day by day. This hazardous condition is affecting the normal life of the people. So, on the basis of this many researches has developed natural fibre reinforced composites and biodegradable polymer which will be less harmful to human being. The idea behind the development of natural fibre and biodegradable polymer is that they have high specific strength and more eco-friendly

as well. But the problem with the natural fibre based composites is that, at high temperature, they are thermally less stable and due to which they are more flammable that synthetic fibres.

In a study made by Skrifvars M and his team [7] on Thermo-mechanical properties of bio-based composites made from lactic acid thermoset resins and flax based fibre reinforcements. In this study they found that the thermal properties are much better than other fibre which helps to find a place in industrial applications.

In another study, Srinivasan [8], during an experiment, found that the hybrid composite of banana with flax has better thermal stability and more flame resistance. During another study[9], when a fibre named Ramie was applied to thermal treatment and the conclusion made was that Ramie fibres has high absorption property and high thermal insulation.

7. Future Outlook

In order to get friendly environment, the entire automotive engineer has the responsibility to developed Eco car which is eco- friendly. It will be a sustainable vehicle for the future which will be running on biofuels.

The panels of the car will be of natural fibre composites in which biodegradable resins will be incorporated as the matrix material.

8. Advantages and Disadvantages

Based on my study, I lead to the some of the advantages and disadvantages from several research papers of natural fibre strengthened polymer composite materials

a) Advantages:

- They are eco-accommodating, biodegradable, accessible in extensive sums, sustainable, modest and have low thickness when contrasted with manufactured filaments, for example, glass, aramid, carbon and steel fibres.
- The disposal of NFRCs is much simpler as compared to SFRCs.
- Natural fibre reinforced composites are used mostly in non-structural applications. And automotive part such as cars doors , bonnet etc are made with NFRCs.

b) Disadvantages:

- The major drawback of NFRC is that, they have high moisture absorbing property due which they reduces the interfacial bonding between the matrix and the fibre which leads to several faults in their mechanical properties.
- They have poor wettability.

Plant fibres can't be utilized straightforwardly in its characteristic shape. It requires synthetic change (Chemical change) to evacuate the waxy layer to improve the interfacial bond amongst fibres and polymer matrix so as to improve the mechanical properties of NFRCs.

8. Conclusion

During the study period, I have found many gathered many conclusions regarding NFRCs. A theoretical study has been done by me on the Natural Fibre Reinforced Composites. The conclusion from both the papers has been discussed below.

Some of the following important conclusions of the study are as follows:

- Natural Fibres plays an important role in today's world.
- Varieties of Natural Fibre Reinforced Composites are developed by Scientist.
- Easily available than other fibres.
- It is low in cost and east to develop.
- Natural Fibres are renewable and can also be recyclable.

Till now many innovations have been done on alternate materials and promoting the natural resources such as plant fibre as reinforcing matrix material. Many fibres like sisal, jute, banana fibres etc. have excellent specific strength and low density. As we know that natural fibres are biodegradable, hence there will be safe disposal of these fibres and there bad effect to the environment.

Natural fibre reinforced materials possess some good mechanical property such as low density, better thermal insulation etc. Along with this, they also have some inherent property such as better dampening and acoustic property because of their porous structure which helps them to gain a large impact on musical instruments. If we use those natural resources in a proper way and in proper selection, we will be able to reduce the use of fossil fuels and promoting those natural fibres and resources in many applications.

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