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Review on Manufacturing of Utility Container Using Sisal Fibres and Epoxy resin

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ABSTRACT

The need for renewable fibre reinforced composites has never been as prevalent as it currently is. Natural fibres that are available in abundance in nature and can easily be produced offer properties such as strength as much as plastic, bio degradability, and cost reduction. The aim of this reviews is to find an alternative to materials that are not bio degradable. Fibres that have been used in the following research are of agave leaf. In this present paper a natural and synthetic fibre composite with epoxy resin is made by using sisal fibre. The samples are analysed for their tensile, flexural and impact strength.

Keywords*— Agave Leaf, Bio-Composite Material, Epoxy Resin*

1. Introduction

There is growing demand for materials that are environmentally friendly and sustainable. One of the areas of focus right now is the transportation/automotive field. To reduce the negative impacts on global air quality, human health and global climate. Several researchers are focusing on bio-based composites. With natural fibers being the prime choice for fiber reinforced composites. Plastics have become the choice for many applications due to their long life and attractive properties. Due to its tremendous growth in applications, plastics are one of the fastest growing segments of the waste stream. Majority of plastic products are made from petroleum-based synthetic polymers that do not degrade in land fill site or in a composite like environment. Ecological concerns have resulted in a renewed interest in natural and compostable materials, and therefore issues such as biodegradability and environmental safety are becoming important. Tailoring new products within a perspective of sustainable development or Eco design is a philosophy that is applied to more and more materials. It is the reason why material components such as natural fibres, biodegradable polymers can be considered as interesting 'environmentally safe' alternatives for the development of new biodegradable composites. Nowadays production of natural biodegradable polymer composites is an important research topic on the stage of renewable sources implementation instead of petrochemical sources. Large variety of natural fibres and their developed surface which increases adhesion to matrix makes them an attractive filler material. In fibre-reinforced composites, the fibres serve as reinforcement by giving strength and stiffness to the structure while the polymer matrix holds the fibres in place so that suitable structural composites can be made.

1.1 Definition of bio composite

A bio composite is a composite material formed by a matrix (resin) and a reinforcement of natural fibres. These kind of materials often mimic the structure of the living materials involved in the process keeping the strengthening properties of the matrix that was used, but always providing biocompatibility. The matrix phase is formed by polymers derived from renewable and non-renewable resources. The matrix is important to protect the fibres from environmental degradation and mechanical damage, to hold the fibres together and to transfer the loads on it. In addition, biofibers are the principal components of bio composites, which are derived from biological origins, for example fibres from crops , recycled wood, waste paper, crop processing by-products or regenerated cellulose fibre (viscose/rayon). The interest in bio composites is rapidly growing in terms of industrial applications. Bio composites can be used alone, or as a complement to standard materials, such as carbon fibre. Advocates of bio composites state that use of these materials

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improve health and safety in their production, are lighter in weight, have a visual appeal similar to that of wood, and are environmentally superior.

1.2 Merits and Demerits of Bio-composites:

- Environment friendly and non-toxic.
- Biodegradable, compostable.
- User friendly and Cheaper.
- Light weight /small density.
- Income Source for rural/agricultural community.
- Renewable and endless supply of raw materials.
- Good Damping.
- Low thermal expansion.
- Low electrical conductivity.
- Easily bondable.
- There are following disadvantages observed by the researchers as follows:
- Damage susceptibility.
- Long manufacturing time.
- Degradation of fibre due to storage for a long time period.
- Low ductility.
- Moisture absorptivity.
- Tendency to form aggregates during processing.
- Relatively low thermal stability and less resistance to moisture.

1.3 Classification of bio composites

Bio composites are divided into non-wood fibres and wood fibres, all of which present cellulose and lignin. The non-wood fibres (natural fibres) are more attractive for the industry due to the physical and mechanical properties which they present. Also, these fibres are relatively long fibres, and present high cellulose content, which delivers a high tensile strength, and degree of cellulose crystallinity, whereas natural fibres have some disadvantages because they have hydroxyl groups (OH) in the fibre that can attract water molecules, and thus, the fibre might swell. This results in voids at the interface of the composite, which will affect the mechanical properties and loss in dimensional stability. The wood fibres have this name because almost than 60% of its mass is wood elements. It presents softwood fibres (long and flexible) and hardwood fibres (shorter and stiffer), and has low degree of cellulose crystallinity. The natural fibres are divided into straw fibers, bast, leaf, seed or fruit, and grass fibers. The fibres most widely used in the industry are flax, jute, hemp, kenaf, sisal and coir. The straw fibers could be found in many parts of the world, and it is an example of a low-cost reinforcement for bio composites. The wood fibers could be recycled or non-recycled. Thus, many polymers as polyethylene (PE), polypropylene (PP), and polyvinyl chloride (PVC) are being used in wood composites industries.

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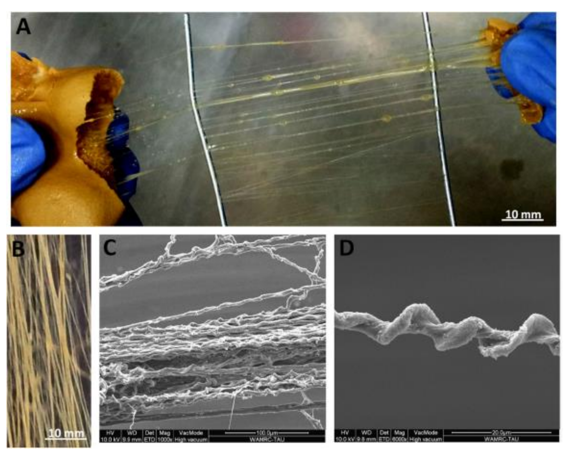
	Non-wood natural fibres				Wood fibres		
	Straw fibres	Grass fibres	Bast	Leaf	Seed/fruits		Recycled
Examples	Rice, wheat, corn straws	Bamboo, Bamboo fibre, switch grass, elephant grass	Kenaf, flax, jute, hemp	Henequen, sisal, pineapple leaf fibre	Cotton, coir, coconut	Soft and hard woods	Newspaper, magazine fibres

2. LITERATURE SURVEY

Mirit Sharabi, Yael Mandelberg, Dafna Benayahu, Yehuda Benayahu, Abdussalam Azem, Rami Haj-Ali [1] studied The bio-composite has hyper elastic behavior and can be tailored to yield mechanical properties similar to native tissues. The micro-structure of the fibers has unique nested coiled arrangement, at both the individual fiber and the bundle levels, which can explain its hyper elastic response. A new simplified nonlinear micro mechanical material model is formulated for the bio-composite in its axial loading mode in order to predict the overall stress–strain relation from the in situ response of the fiber and matrix constituents. The prediction of the model has been verified against tested bio- composites with different fiber volume ratios.



Brijesh Kumar Patel, Vinod Kumar Verma, A. K. Rai & Abhishek Gaikwad [2] studied the tensile, compressive and flexural strength of the developed composites of different weight percentages of fly ash, human hair are significant. With the consideration, based on the application and strength required, the weight percentage of the fly ash in fly ash, human hair could be varied with fixed weight percentage of epoxy resin. Thus the developed composites would be a high performing, economical wood substitute.

Aman S. Pawar & Abhishek Gaikwad [3] studied The maximum flexural strength is 111.15 N/mm2, maximum compression strength is 61.93 N/mm2 and maximum impact strength recorded is 100.5 J/m of E2 specimen, which contain 20% of banana fiber & 20% of sisal fiber of the total wt% of the specimen fabricated. It is suggested from the experimental Study that specimen E2 can bear up the higher loads when

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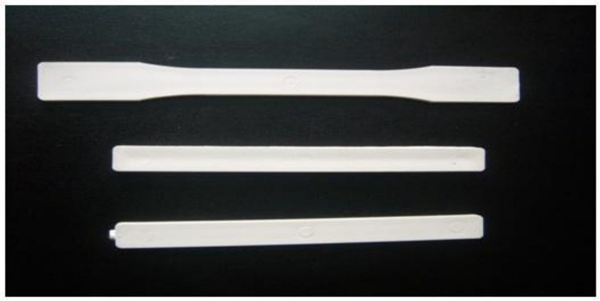
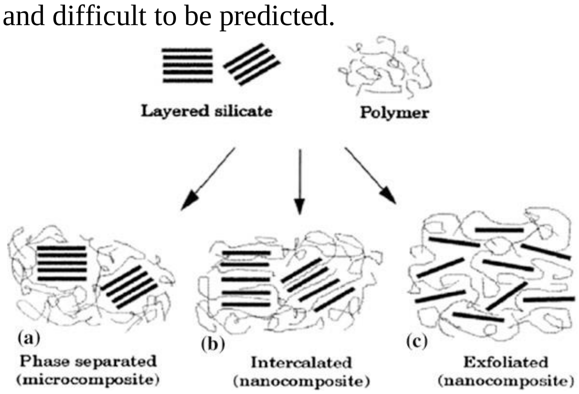
compared to the other specimen combinations, and can be used as an alternate materials for usual uses. They have lot of advantages like low density, low price, recyclable, biodegradable, low abrasive wear, and environment friendly.

Dr. Mohammed Haneef, Dr. J. Fazlur Rahman, Dr. Mohammed Yunus, Mr. Syed Zameer, Mr. Shanawaz Patil, Prof. Tajuddin Yezdani [4] studied Technically teak wood can provide maximum strength fibreboards, but economics of the material may force alternatives. Plywood manufactured by rice husk promise good and almost comparable strength. Although these plywood can also be manufactured by some other bio-waste like sugarcane bagasse but there are possible fungal infection in these material over a period of time.



Faris M. AL-Oqla and Mohammad A. Omari [5] studied Bio-composite materials have been adopted in various applications. However, their implementations as alternatives for conventional materials are relatively slow. This is due to the fact that bio-composites have several limitations and barriers for development comparable to traditional materials. The inherent characteristics of their constituents are one of these limitations. In additions, the improper compatibilities between the fillers and matrices make the performance uncontrollable and difficult to be predicted.



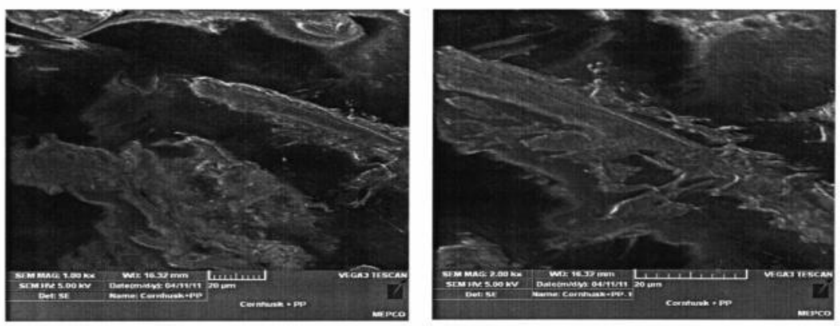
V.Subashini, N.Sakthieswaran, G.Shiny Brintha , O.Ganesh Babu [6] studied that the natural fibre composites are good alternative for the conventional construction materials. They are renewable, cheap, recyclable, and biodegradable. Sisal fibre possesses high specific strength and modulus, low price, recyclability, easy availability. Glass fibres bulk and weight properties are also very favourable when compared to metal. Basalt is the natural material that is found in volcanic rocks. It possesses high thermal and sound insulation production. Vinyl ester resin is becoming increasingly important for fibre reinforced composites. By using these materials the composites are prepared and analysed for its tensile, flexural, impact strength.

Dr A Thimmana Gouda, Jagadish S P, Dr K R Dinesh, Virupaksha Gouda H, Dr N rashanth [7] studied From the Tensile Experimental test results it is found that 12%, 24% and 36% HNFPCM will match the Femur bone tensile property anyhow from this results we suggest 36% HNFPCM is the best material which is having high Tensile strength, high Density when compare to 12% & 24% HNFPCM. From the

Compression Experimental test results it is found that 12%, 24% and 36% HNFPCM will match the Femur bone Compression property anyhow from this results we suggest 36% HNFPCM is the best material which is having high Compressive strength, high Density when compare to 12% & 24% HNFPCM. From the Bending Experimental test results it is found that 12%, 24% and 36% HNFPCM will match the Femur bone Bending property anyhow from this results we suggest 36% HNFPCM is the best material which is having high Bending strength, high Density when compare to 12% & 24% HNFPCM.

(a)Sisal Fiber (b)Jute Fiber (c) Hemp Fiber

N. Jaya Chitra and R.Vasanthakumari [8] studied the tensile strength has reduced for the bio composites when compared to virgin polypropylene. Although there was also a reduction in strength as the corn husk percentage increases, the modulus shows a drastic increase in percentage of corn husk powder. The morphology of the bio composites was characterized using Scanning Electron Microscope (SEM) from which fairly good compatibility between polypropylene and corn husk powder was observed. The thermal stability was characterized using Thermo Gravimetric Analysis (TGA). The thermal stability was also found to be high for the bio composites when compare to virgin polypropylene. The melting temperature and thermal degradation temperature were examined using Differential Thermal Analysis (DTA). The melting temperature and the thermal stability were found to be higher in composites when compared to the virgin polypropylene.



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Mr. Vignesh M, Dr. H. G. Hanumantharaju, Mr. Avinash S [9] studied Bio-composites can supplement and eventually replace petroleum based composite materials in several applications thus offering new agricultural, environmental, manufacturing and consumer benefits.

Shailesh Kumar singh, Prabhat Kumar Sinha and Earnest Vinay Prakash [10] studied the wastage generated during the extraction of the fibre is 20 %. The soaking time for the present chemical composition yields the very good flxural properties .which is evidenced from the experimental results. The mechanical properties of the palmyra palm petiole FRP composites given enough confidence to fabricate light weight and reasonably good strength parts for automobile door panels, house hold applications like doors, window frames etc .

Aman S. Pawar & Abhishek Gaikwad [11] studied the use of natural and agricultural wastes, which are present in abundance in nature & whose production can also be increased as per the need. In the present study, bio composite materials were developed, in which Natural fibres i.e. Banana, Sisal, and Wheat Straw fibre were used as reinforcing materials with Epoxy resin CY-230 and Hardener HY-951. In this Study, the mechanical properties such as Flexural, Compression and Impact Strengths of the specimens with different composition were tested and compared. Fabrication of different specimens was done by using hand layout technique. Bio-composite samples were developed with different composition of constituents. Mechanical tests were conducted according to ASTM and ISO standards and their properties were analysed. It has been observed that equal weight percentage of Banana & Sisal fibers i.e. specimen E2 possess much better mechanical properties.

Figure 3: Compression Test Specimen

3. Material properties

• Fibers of Agave leaf: Fibres used in the manufacturing are obtained from agave leaves. In previous researches, researchers have found that it has a flexural strength of 81.95 N/mm2.
• Epoxy resin: It has the following outstanding properties : Excellent adhesion to many different materials Great strength, toughness and resilience Excellent resistance to chemical attack and to moisture Outstanding electrical insulating properties Absence of volatiles on curing Negligible shrinkage Other epoxy resins for bonding, casting, tooling, pattern making, surface coating, lamination and concrete repairs are available.

4. Methodology

• Collecting raw Agave plant leaves.
• Cleaning and soaking of leaves.
• Extraction of fibres from leaves.
• The casting of Container using epoxy resin.
• Determining the results by testing the samples.

Method used: Hand lay-up

Hand lay-up is a moulding process where fiber reinforcements are placed by hand then wet with resin. The manual nature of this process allows for almost any reinforcing material to be considered, chopped strand or mat. Similarly, the resin and catalyst blend can be manipulated to allow for ideal processing conditions.

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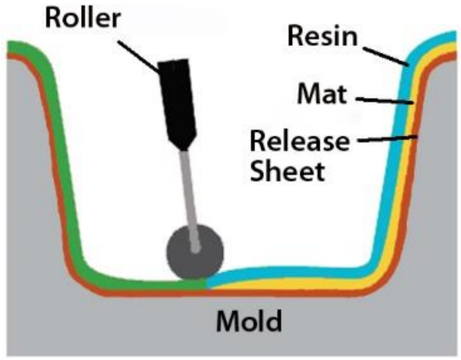

5. Conclusion

It can be seen that bio-composite material has potential to replace plastic. Sisal fibre possesses high specific strength and modulus, low price, recyclability, easy availability. Thus strength in the container made of the bio composite material is good for a domestic utility container and can be used as storage container it does not react with water and possesses high strength. However, new process development for bio-composite fabrications for commercial applications is the real challenge of research at the current level of technology so far developed for bio-composites.

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