A Review On Extraction Methods Of Bamboo Fibers And Banana Fibers

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Abstract-Natural plant fibres reinforced polymeric composite materials have been used in many fields of our lives to save the environment. Especially, bamboo fibres due to its environmental sustainability, mechanical properties, and recyclability have been utilized as reinforced polymer matrix composite in construction industries. In this review study bamboo structure and three different methods such as mechanical, chemical and combination of mechanical and chemical to extract fibres from bamboo are summarized. Each extraction method has been done base on the application of bamboo. In addition Bamboo fibre is compared with glass fibre from various aspects and in some parts it has advantages over the glass fibre. Another important natural fiber is banana fiber among which is widely used in various applications. Banana fiber is eco-friendly like jute Fiber. It has huge fare request from numerous nations like Japan, Australia, Germany and many. Fiber can be acquired from entire banana plant. After the organic product is gotten, the plant is discarded offering ascend to squander. The correct transfer of this plant is another issue. By utilizing a decent fiber extractor machine, a lot of fiber can be acquired which will offer ascent to extra salary. Banana fiber is a best fiber with generally great mechanical properties because of its high alpha cellulose and low lignin percentage. The present paper describes methods of extraction of bamboo fibers and banana fibers.

Keywords-Bamboo fibers,Banana fibers composite,Extraction,Squander,

I. INTRODUCTION

1.1. Bamboo Fiber
Due to their ease of production and high mechanical properties, carbon, graphite and glass fibre-reinforced polymer composites have been used in various industries. These polymer matrix composites have been widely investigated for their high performance. Due to their non-recyclable and non-degradable properties, their end of life disposal mode is unknown. Giving importance to the climate change and environment, researchers are interested in using natural fibres in the place of synthetic fibres. Natural fibres are classified as animal fibres containing protein such as silk, wool, hair, etc., and plant fibres – bamboo, sisal, hemp, flax, etc. There are four main ingredients in the plant fibres: lignin, pectin, cellulose and hemicellulose. Efficiency of the plant fibre reinforcement is defined by the type of cellulose and crystallinity. There are seven categories of plant fibres namely – grass, stalk, wood, fruit, seed, bast, and leaf. Bamboo belongs to a grass family called Bambusoideae and when compared with other plant fibres, bamboo has got several advantages such as low cost, low density, high growth rate, stiffness and high mechanical strength. Difficulty in extracting straight and fine fibres, degradation with temperature during manufacturing and high moisture content are some of the disadvantages of bamboo for various applications.

1.1.1. Distribution of bamboo globally
In numerous continents of the world, bamboo is developed and its locale can be ordered likewise: Asia-Pacific bamboo district, American bamboo area, African bamboo district and European bamboo
district. Asia-Pacific bamboo district nations incorporate India, China, Burma, Bangladesh, Thailand, Cambodia, Japan, Vietnam, Indonesia, Philippines, Sri Lanka, Korea and Malaysia. American bamboo district nations incorporate Guatemala, Mexico, Costa Rica, Honduras, Nicaragua, Columbia, Brazil and Venezuela. African bamboo locale nations incorporate Eastern Sudan and Mozambique. European bamboo district nations incorporate France, England, Germany, Belgium, Italy and Holland. Around 65% of the world’s bamboo is in the Asian landmass and the rest are in alternate mainlands. Henceforth, Asian landmass is the area with biggest bamboo populace on the planet.

1.1.2. Structure of bamboo

Bamboo grass consists of culm, which is a hollow cylinder with its inside having several diaphragms, while outside of the culm appear as rings. The space or gap between the two rings is known as „internode“. The distance between each node is different for each species. There are several vascular bundles in the culm wall of bamboo, which provides strength to the culm. Consequently, the bamboo species is characterized by its number of vascular bundles, density and average size. Their physical properties and usability are reflected by the anatomy of bamboo culm. With the decreasing upper diameter of the bamboo culm, the fibre density increases. So the top section of the bamboo culm has higher strength than the base section.

1.1.3 Chemical composition of bamboo

Lignin, cellulose and hemicellulose are the important components in bamboo and these components constitute 90% of the total weight of bamboo. Other important constituents of bamboo are pectin, fat, protein, tannin, ash and pigments. Physiological activity of the bamboo is determined by these components. The chemical composition of bamboo keeps changing with age. With increase in age, the cellulose content keeps on decreasing and the chemical composition of bamboo is affected directly. Bamboo gets its stiffness and yellow colour from the lignin content. Since lignin is quite resistant to various alkalis, all lignin content cannot be removed by different treatments. Noncellulosic components of the bamboo contribute to properties such as density, moisture, flexibility and strength.

1.2. Banana Fiber

Brazil harvested 6.78 million tons of banana in 2009 and is one of the greatest world producers. In Sao Paulo State, Vale do Rio Ribeira do Iguape (Ribeira Valley) region is a great and important producer of this fruit. Ribeira Valley region, which covers 23% of the remaining Atlantic Forest of Brazil; was included by UNESCO, in 1999, in World Heritage List because of its natural, social, environmental and cultural importance. Contrasting with the rich environmental and cultural heritage, its Human Development Index (HDI) is one of the lowest of the country, and it has also the higher rates of infant mortality and illiteracy. Banana plantation occupies large part of the land, but it is a contamination source because after harvest, the tree is cut down and abandoned in the fields, which foments Sigatoka, a group of fungal diseases that destroy banana leaves and reduce crop yield. These residues represent 40% of banana production. Research about this waste is important to Ribeira Valley sustainable development, either to raise its population HDI without changing their important economic activity or to avoid Sigatoka spread. There are already some suggestions to its utilization. A study suggested that banana pseudostem core could be turned into heart of palm, recommending that heat treatment temperature should be 120 °C for 5 to 10 minutes. There is a registered patent that describes a process to use the heart of banana tree for human consumption. There are also some cooperatives which turn pseudostem fiber into handcrafts. Evaluation of this activity in Ribeira Valley communities called ‘quilombolas’ was done, and the conclusion was that it is compatible with the concepts of eco-development. Other suggestions for the residue include the manufacture of blades, veneer and plywood and cloth for lampshades, boxes, cases and internal
coating of automobiles. In agriculture, it was suggested that pseudostem could be enriched with nitrogen and phosphorus to be used as substrate for growing ferns. In construction, application of the fiber in PVC composites improved tensile strength and resistance against impact. It has been also suggested that biogas could be produced with this material. To obtain pulp or paper sheet could be a good alternative also because pseudostem fibers have good morphological characteristics, favoring production of cellulose with good mechanical strength. In Itariri city there is a company that already processes pseudostem to produce cellulose pulp and paper. The company technical conditions to process pseudostem is too time and energy consuming though. One of the difficulties lies in its high water content (above 90%). Therefore, apart from fibers, if heart, juice or other parts of pseudostem could be separated and utilized for goods production, the contribution to people who live in Vale do Ribeira region would be important. The idea of this paper was to study pseudostem sap through chemical and microbiological analyses in order to check the technical feasibility to transform it in a sport drink.

II. EXTRACTION OF BAMBOO FIBER

2.1 Mechanical Extraction
This method involves different mechanical procedures such as steam explosion or heat steaming, high pressure refinery, crushing and super grinding. All these mechanical methods have some advantages and disadvantages. For instance, in heat steaming method the natural strength of the bamboo fibers reduce. The steam explosion procedure can remove lignin from the woody materials of a plant. Shunliu et al. used steam explosion Mechanical Extraction. This method involves different mechanical procedures such as steam explosion or heat steaming, high pressure refinery, crushing and super grinding. All these mechanical methods have some advantages and disadvantages. For instance, in heat steaming method the natural strength of the bamboo fibers reduce. The steam explosion procedure can remove lignin from the woody materials of a plant. Shunliu et al. used steam explosion to extract fiber from bamboo. In this method the bamboo chips were exploded under 2 MPa pressure and 210°C temperatures for 5 minutes. The lignin is discharged from the cell wall and covered the surface of the fiber. Kazuya et al. used the same method but they were not able to remove lignin completely from the fibers.

The method that was utilized as a part of compound system was degumming and in mechanical the fibers were extracted using retting process. They found that substance strategy to separate fiber regardless of being costly, decreasing the elasticity and modulus; it could build the strain in correlation with mechanical strategies. In addition mechanical process is more eco-accommodating. Osorio et al. extracted fiber with an unadulterated novel mechanical system. In this procedure they could extricate long and fine fiber and the mechanical properties of treated strands with different grouping of salt and untreated filaments were analyzed. In untreated fiber the longitudinal flexural quality was the most noteworthy.

2.2 Chemical assisted natural retting (CAN)
First of all, nodes of raw bamboo were detached and residual part was cleaved in longitudinal direction to thin slabs with 15 - 20 cm in length and 1.5 - 2 mm in thickness by the slicer. Finally, they were converted manually into fiber bundles. These bundles were then immersed in Zn(NO3)2 solution using material to liquor ratio 1: 20 at 40 °C at neutral pH for time period of 116 h in BOD incubator. Then they were boiled in water for one hour. The concentrations of Zn(NO3)2 were 1%, 2% and 3% (owf).
2.2.1 Acid Retting
The bamboo fibre bundles with the same dimensions as mentioned above were soaked in 1% HCl (owf) solution using material to liquor ratio 1 : 20 at room temperature for 45 min. Finally, they were washed with fresh water and dried under shadow.

2.2.2 Alkaline Retting
Alkaline retting was carried out by soaking the bamboo fibre bundles of same dimensions as mentioned earlier in section 2.1.2, in 2 g/L Na2CO3 and 0.5% Lissapol D solution using material to liquor ratio 1 : 20 at 80 °C for 45 min. Finally, they were washed with fresh water and dried under shadow.

Optimization of Na2CO3 concentration for Scouring
The CAN, acid and alkaline retted bamboo fibers were treated with sodium carbonate 5-30 g/L, Lissapol-D 0.5 g/L and kept at 80 °C for 45 min with fiber to liquor ratio 1:20. The concentrations of sodium carbonate were 5g/L, 10 g/L, 15 g/L, 20 g/L and 30 g/L. At the end of scouring treatment, the fibers were neutralized with acetic acid. After neutralizing, the samples were rinsed successively with hot and cold water, detergent solution (70 °C, 5 min), and finally rinsed in cold water and air-dried.

2.2.3 Combined Chemical and Mechanical Extraction
Usually after alkali treatment and chemical treatment, compression moulding technique (CMT) and roller mill technique (RMT) are used to extract fibres. In a research study, a bed of alkaline treated bamboo strips between two flat platens were pressurized under a load of 10 tons using CMT. To separate high quality fibres, starting bed thickness and compression time are important factors to be considered. In the RMT, two rollers with one fixed and other rotated were used and the treated bamboo strips were forced between two rollers. In both compression moulding technique and roller mill technique, bamboo strips are flattened and the combination of alkaline and mechanical extraction enabled the easy separation of fibres from bamboo strips.

III. EXTRACTION OF BANANA FIBER

3.1 Manual Method
Banana fiber can be obtained from waste stalk, leaf and roots of banana plant. Generally abundant of banana fiber is obtained from surface near to the outer sheath of stem. It can be peeled-off easily in ribbons of strips of 5-10 cm wide and 2-5 mm thick along the entire length of the sheath. The undressing process is known as Tuxying and the ribbons are called as Tuxies.

3.1.1 Bacnis Process
It is the simple stripping process in which trunks are pulled apart and sheath is undressed. The fiber is obtained by removing pulpy and pulling away the ribbons (tuxy).

3.1.2 Loenit Process
In this process a knife or any sharp pointed tool is used for obtaining ribbons. Ribbons are obtained from one sheath at a time. 20-25 kg of fiber is dried, cleaned and bundled.

3.2 Chemical Extraction
For chemical extraction, alkali treatment is used. The alkali NaOH reduces roughness of fiber and good quality of fiber is obtained. In addition, sulfuric acid, hydrogen peroxide, protease, pectinase and sodium citrate were used.
Fiber-OH + NaOH -------Fiber-O-Na++ H2O
Thus main disadvantage of chemical extraction is time period taken in the whole process. It can be seen from above graph to produce good quality fiber; chemical extraction takes 35-40 days. The process is costly. There is lot of wastage in the process.

3.3 Mechanical Extraction
Major components of machine are rotating roller, stationary roller, feeding gear mechanism, motors, and belt is provided for transfer of motion and torque and whole system is supported by frame. But in present machines there are knot formation and breaking of Fibers this problem overcome our conceptual design of machine. Impurities in the rolled Fibers such as Pigments, broken Fibers, coating of cellulose etc. were removed manually by means of comb.

Fig 1. Banana fiber extraction machine
Fibers produced are not of uniform, more Wastages of Fibers, More costly machine, less production, poor Fiber quality, more Time consuming and also major drawback of these types of existing machine complete psedostem not to be used to extract Fiber, before extraction first separate thin sizes slices from psedostem in this area more labour required. Unnecessary delay of process and directly effect on production spatially in rainy season there are shortages of labour. We are survey manufacturer, dealer and customer they are get interesting to overcome these problem. For the ease and comfort of operator, the height of machine should be properly decided so that he may not get
tired during operation. The machine should be slightly higher than the waist level. Enough clearance should be provided from ground for cleaning purpose. 4 hacksaw blades, 0.5hp motor are used. Motor is used to provide input power to machine. And two roller are used to the crushing of banana pulpy part.

It is simple machine consisting of single roller which rolls on fixed support. The roller is provided with horizontal hacksaw blades. Generally, 4 hacksaw blades are used. 0.5Hp motor is used to provide input power to machine. The motor is runs and the rollers are rotates the banana pseudo stems. The machine reduces labour work and increases fiber production compared to manual process. In this process, cut stems of banana plants of 100-200 cm in length are crushed between two rollers. Due to crushing the pulpy part is removed and fiber is obtained. And the fiber are taken to the machining process. The lengthy fibers are taken.

IV. CONCLUSION

Because of its high development rate and high quality, bamboo fiber has numerous advantages over other plant fibers. Contrasted with glass fibers, bamboo fiber has numerous points of interest and this has created awesome enthusiasm among analysts for utilizing bamboo fiber as reinforcement in polymer composite materials. Based on their application in various fields of study and in various fields, different extraction methods have been utilized to extract bamboo filaments. In this study, numerous extraction methods have been reviewed and some of them have advantages over the others.

For extraction of banana fibers, manual, mechanical and chemical methods are available among which mechanical method that is using extraction machine is more popular. Although there are various designs of banana fiber extraction machine but it is needed to design new fiber extraction machine with higher efficiency which will reduce manual efforts and suitable for mass production.

REFERENCES


