International Journal of Science and Research (IJSR) ISSN: 2319-7064 Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Design and Fabrication of Plantain (BANANA) Fiber Extracting Mechanism

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Abstract: Objective of the present paper is to design and fabrication of banana fiber extraction equipment to develop high quality banana fiber from banana pseudo stems. Banana fiber offers good mechanical properties. This plant fiber has long been a better source for high quality textiles industries in many parts of the world, especially in Japan and Nepal. Manually extraction of the banana fiber requires proper procedure and its time consuming. Labor expense is also high. Now day's machines exist for extracting banana fiber with mass production. The number of machines is currently available nowadays, but quality obtained is not up to the optimum level. This can be overcome by fabricating the designing of an extracting mechanism of banana fiber from plant's pseudo-stem, designing a rotor assembly which consisting of two disks on which six blunt blades are mounted, and a shaft design to drive this rotor assembly and the pulley and powering system for the machine. This paper specifies the new model of machine and its working operation.

Keywords: Plantain Fiber, Jute Fiber, Pseudo Stems, Extraction Mechanism.

1. Introduction

Banana fiber extracting industry is a large and growing industry. Banana fiber is eco-friendly like jute fiber. The technology of plantain fiber extraction has been developed in south-India where in a good number of plantain fiber extraction units have been running successfully. Some firms are exporting plantain fiber products because of the greater demand. Banana growing states of North East region as adopted the technique from south and started production of plantain fiber. The natural fiber is renewable, non-abrasive, bio-degradable entity.



Figure 1.1: Pseudo Stems



Figure 1.2: Banana Plant

It offers good calorific value and exhibit excellent mechanical properties and is inexpensive. This good environmental friendly feature makes the material very popular in engineering applications such as automotive, textile and constructive industry. The banana plant fibers are the agricultural residue of the parent cultivation. Therefore extraction of these fibers through proper equipment helps to attain specific research areas and applications.

2. Literature Review

Banana has long been considered a food, fruit and fodder crop. In addition to this, now a day, it is also gaining importance as a source of fibers. India is the largest producer of banana in the world with an estimated annual output of 13.5 million tons, of which 80% is generated from six states, namely, Tamilnadu, Maharashtra, Karnataka, Kerala Andhra Pradesh and Gujarat. Annually about 1.5 million tons of dry banana fibers can be produced from the outer sheath of pseudo stem. Being a rich source of natural fibers, the pseudo stem can be profitably utilized for numerous applications and preparation of various products. In order to know the previous reported details of banana fiber production and utilization and blending possibilities, a literature review was carried out. Following are the some of the findings related to banana plantain fiber:

- Banana plant fiber as a substitute for Jute, Banana Plant fiber is strong, soft, and coarse and technique developed for processing the fiber on standard jute machinery is reported.
- The banana fiber was also blended with Mesta (cellulosic fiber). The banana 82 fiber spin ability and weaving performance were invested, so that it can be used as a good substitute for jute in making of sacks and packaging materials.
- Jute Technological Research Laboratories, (JTR Lab) Calcutta73, carried out an experiment work, (1974) on rope making with banana plant fiber. It was concluded that banana fiber can replace certain percentage of Mesta, a cellulosic fiber in the composition of agricultural ropes.

Volume 7 Issue 10, October 2018 www.ijsr.net

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3. Problem Definition

The rising interest in natural fibers in the composites field is undeniable, mainly due to sustainability, but also because of their good mechanical properties and low cost. Since natural fiber is available widely across the specific location depending upon the nature of plant available in the selected area, hence the fiber plays a vital role in all the technical applications.

Banana fiber is obtained from the superimposed leaves forming the pseudo stem of the plant, which currently has no use; apart from a low percentage dedicated to cattle feed. It belongs to Musa genre, as a monocot.

Banana fibers are made of cellulose (43.6%), hemicelluloses (14%), lignin (11%) and other substances (such as pectin, wax, and 31.4%). This extracted part from the specific plant finds its use in various technical and agricultural applications. Hence the fiber extraction can be considered as important activity for any research oriented ventures.

4. Design of Components

In this design procedure and Parts like square stand, rotor blade, shaft, ball bearing, v-belt, sheet metal, and induction motor are discussed:

4.1 Design of Bearings

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made upon steel material and bearing cap is mild steel.

Bearing No. 6202

Outer Diameter of Bearing (D)	35 mm		
Thickness of Bearing (B)	12 mm		
Inner Diameter of the Bearing (d)	15 mm		
Maximum Speed	14,000 rpm		
Mean Diameter (d _m)	(D + d) / 2		
	(35 + 15) / 2		
d _m	25 mm		

 Table 4.1: Bearings Specifications

4.2 Design of Shaft

A shaft is a rotating member usually of circular cross-section (solid or hollow), which transmits power and rotational motion. Machine elements such as gears, pulleys (sheaves), flywheels, clutches, and sprockets are mounted on the shaft and are used to transmit power from the driving device (motor or engine) through a machine. The shaft rotates on rolling contact bearings or bush bearings.



Figure 4.1: Loads on Shafts

4.3 Rotor

The rotor consists of copper or aluminum bars connected together at the ends with rings. As magnetic flux cuts across the rotor bars, a voltage is induced in them, much as a voltage is induced in the secondary winding of a transformer. Because the rotor bars are part of a closed circuit (including the end rings), a current circulates in them.



Figure 4.2: Rotor Parts

4.4 AC-Motor

An electric motor is an electromechanical device that converts electrical energy into mechanical energy.



Figure 4.3: Ac-Motor

Most electric motors operate through the interaction of magnetic fields and current-carrying conductors to generate force. The reverse process, producing electrical energy from mechanical energy, is done generators such as an alternator or a dynamo some electric motors can also be used as generators.

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4.5 Spur Gear



Figure 4.4: Spur Gear

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly but less commonly) the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts.

5. Fabrication

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Sl. No.	Components	Material	Quantity
1.	Frame	M.S	4
2.	Rotor	AL	1
3.	AC-motor	-	1
4.	Spur gear	C.I	6
5.	Bracket	M.S	6

 Table 5.2: Fabrication Requirements

5.1 Frame

A frame is made of mild steel. This mild steel is turned into a square pipe which is fabricated and made to form a frame which holds the entire components. mild steel contains approximately .05-.25% of carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is low cost and easy to form, surface hardness can be increased through carburizing.



Figure 5.1: Frame

The fabrication is done by considering mild steel material as frame. This material is cut as per the required dimension to make the frame body. Welding and process are employed to get required shape and to assemble the various components to the equipment.

Various stages of fabrication are shown in the following fig:



Figure 5.2: Surface Finishing



Figure 5.3: Cutting the Frame

Finally, a fabricated model as per the dimension consisting of all the assembled parts is shown in the fig



Figure 5.4: Assembled Fabricated Model

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Figure 5.5: Iso Metric View

6. Working Operation

The single phase supply is given to the induction motor, it will run. The motor pulley is coupled to the spur gear pulley with the help of belt. The spur gear arrangement is run according to the speed of the motor. Before switch on the induction motor, the banana fiber extracting wire is locked to the lock nut in the banana fiber extracting shaft. The banana fiber extracting wire is supply by a banana fiber extracting wire tare. The tare is fixed to the frame stand by two end bearings, so that it will run freely according to the speed of the banana fiber extracting shaft. The banana fiber extracting shaft is rotated when the single phase induction motor switched ON.



Figure 6.1: Banana Fiber Extracting Machine

7. Conclusion

This enzymatic treatment has proven to be useful for banana fiber treatment, achieving an improvement in terms of cleanliness and fibrillation. Enzymatic treatments improve the thermal stability of fibers by the removal of pectin and hemicelluloses, while producing a slight decrease in mechanical properties, probably due to defibrillation found under SEM observations.

Banana fiber can be spun to produce yarns, mixed or not mixed with other fibers, while the most suitable for industrial scale-up without major equipment changes would be the blend of banana fiber and wool.

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DOI: 10.21275/ART20191808