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Design and Fabrication of Multi Fiber Extraction Machine

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ABSTRACT

The interest of using natural plant fiber is increasing. Nowadays Natural fibers are preferable than synthetic fiber for their appropriate stiffness, mechanical properties and high disposability. There are two ways of plant stem fiber extraction adopted. These are stripping and decortications by a decorticator. Manual extraction of fibers by stripping method is tedious, time consuming and cannot be recommended for industrial application. A decorticator is a machine used for extraction of fiber from the skin, bark, or rind off nuts, wood, plant stalks etc. It is a semi-automatic machine used in the production of natural plant stem fiber extraction but it is expensive and not available in Ethiopia.

The country had an agricultural lead economy, producing a variety of cereals, fruits, vegetables and cash crops. The Authors designed and fabricated plant stem fiber extraction machine. The machine has a horizontal drum whereby a drum has two different surfaces. On the first half drum surface, small nails are closely welded in order used to extract fiber from plant stem which have a flat surface like, banana plant, sisal plant etc. The second half drum surface is grooved used to extract fiber from plant stem which have a circular shape like papyrus plant. The fiber extraction could be performed simply by feeding a cleaned part of the stem through feeding unit of machine. In the country there is no electromechanical plant fiber extraction machine. Some plant fiber extractor's uses manual extraction of plant fiber. Fabricated plant stem fiber extraction machine have a higher production than manual extraction. The Authors fabricated the machine for the first time in the country and some modification may be required in the future.

KEYWORDS: *Fiber; Fiber Extraction, Decorticating; Stripping*

I. INTRODUCTION

The interest in using natural fibers has increased significantly in the last few years. The abundance in nature combined with the ease of its processing was an attractive feature, which makes it an important substitute for synthetic fibers which were potentially toxic. Natural plant stem fibers possess many characteristics which make their use advantageous: low cost, low density, biological degradability, renewability, good mechanical properties and non-toxic. Now a day, Natural fibers are preferable for their appropriate stiffness, mechanical properties and high disposability [1-5].

There are two ways of fiber extraction adopted. These are stripping and decortications by a decorticator. Stripping is a manual extraction of

plant fiber. Plant stem sections were cut from the main stem of the plant and then rolled lightly to remove manually by means of comb, and then the fibers were cleaned and dried. Manual extraction of fibers was tedious, time consuming and cannot be recommended for industrial application. A decorticator is a machine used for extraction of fiber from the skin, bark, or rind off nuts, wood, plant stalks etc. It can be used in the fiber extraction of banana stem, pineapple leaf, sisal, papyrus and so on. It is a semi-automatic machine used in the production of natural plant stem fiber extraction but it is expensive and not available in Ethiopia [6-12].

Ethiopia had an agricultural lead economy, producing a variety of cereals, fruits, vegetables and cash crops. Besides the main agricultural products, different parts of the plants and fruits of many crops may be viable sources of raw material for industrial utilization [13-16]. In the country shortage of raw materials was a notable hindrance limiting the industrial growth. Besides the main agricultural products, different parts of the plants and fruits of many crops may be viable sources of raw material for industrial utilization, but only part of this material was exploited profitably because of lack of knowledge of the technology for its economic use and so much was returned to nature unused. In country textile industries there is shortage of raw materials especially the amount of cotton harvested cannot meet the great demand by Ethiopian Textile industry. In the country there is high amount of plant stem which have a fiber were dumped as waste, farmers often face the problem of disposal stems and these huge stocks were getting accumulated [17-21]. The present work aims at fabricating multi fiber extraction with less manufacturing cost with high production.

II. Methodology

Materials

Hollow Structural Sections of circular (CHS) pipe, Motor, Rectangular (RHS), Tubular steel, Sheet Metal, Bearing, pulley, Belt, Nails, Socket, C-channel iron, Shaft Angular iron etc., were used in fabrication work.

Methods

The main aim of this project is designing and fabricating multi fiber extraction machine. In the market there are different single fiber type extracting machines but this machine used to extract different types of fiber.

Design of multi fiber extraction machine parts

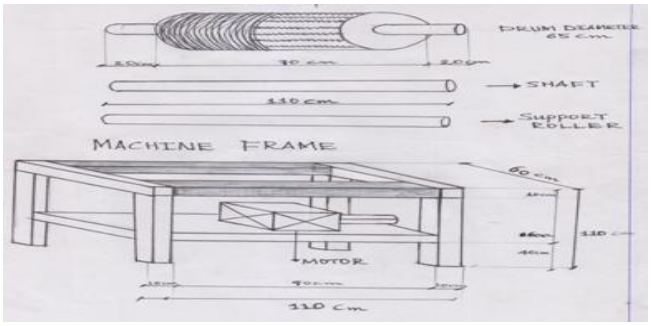

Fig 1. Plant Stem Fiber Extraction Machine design parts

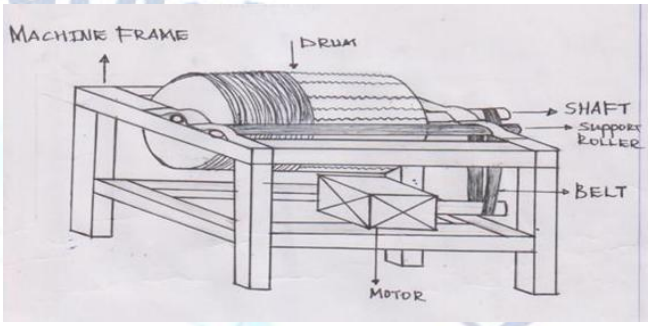

Fig 2. Plant Stem Fiber Extraction Machine design

Fiber extraction drum

Different types of fiber extraction process are followed in different areas of world. Based on the type of plant stem fiber arrangement in plant stem, the Authors fabricated extraction drum unit which used for the extraction of fiber from different plant stem. The extraction drum has 75cm length 75cm and 65cm circumference. As indicated in Figure 1, the drum has two different surfaces. On the half length of drum surface, small nails are welded closely based on fiber arrangement of plant stem and the half length has grooved drum surface. Nail welded drum surface have a length of 35cm and the nails are welded on the drum by having 1.2cm gap between nails at 90 degree to the drum length. Nail welded drum surface used to extract fiber from plant stem which have a flat surface like, banana plant, sisal plant etc. Grooved drum surface have a length of 35cm and the grooved have a gap of 0.25 inch each other and each groove have a depth of 0.35 inch grooved drum surface used to extract fiber from plant stem which have a circular shape like papyrus plant.

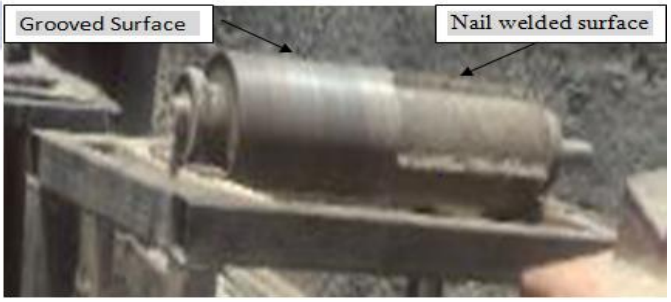

Fig 3. Fiber extraction drum

Fiber Extraction Machine frame

Fig 4. Fiber Extraction Machine frame

As indicated in Figure 4, the machine frame is made 60mmx60mmx2mm Rectangular tubular iron steel used to carry out machine parts. To machine frame has a dimension 110cm height, 90cm Length and 60cm width.

Machine Motor

An electric motor is an electrical machine that converts electrical energy. As indicated in Figure 5, the Authors used 2HP electrical motor with 900 rpm. The machine motor is connected with main shaft by using two v-belts.

Fig 5. Machine Motor

Plant stem feeding and machine protecting unit

As indicated in Figure 5, the machine has two fixed plant stem feeding roller. The Authors used 0.75mm thickness sheet metal, which used to cover drum. Sheet metal is used to protect machine operators from danger. Because when the drum starts running it may cause danger to operators.

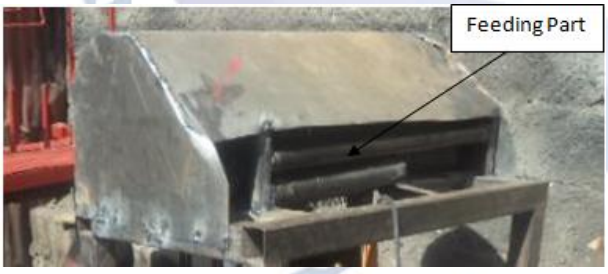

Fig 6. Fiber Stem Feeding Part

III. Result and Discussion

Description of plant stem fiber extraction machine

Plant stem fiber decorticating machine used to extract fiber from different plant stem. Various plant stem fiber can pass through two feed rollers, which used to feed plant stem to drum. The drum has two different surfaces for use different fiber extraction. The drum has a shaft holding extraction drum and at two edge of the shaft. there are two bearing with their bearing house. At one edge of shaft there are two fixed pulleys. The motor under the drum has two pulleys. The shaft pulleys and motor pulleys are connected by two V-belts. When the motor starts rotation, the belt will drive the shaft. The drum which fixed on the shaft starts rotation and drum can start extraction of fiber from plant stem. The machine has a socket used to connect with a power source. The drum is covered with a sheet metal in order to protect the operator from danger.

Fig: 7 Fiber extraction machine

As indicated in Figure 7, fabricated plant stem fiber extraction machine used to extract different plant stems, like banana plant, sisal plant, papyrus plant and etc.

Table 1: Machine specification

S/N	Specification	Description
1	Type of machine	Multi plant stem fiber extraction machine
2	Uses	Extract fiber from plant stem
3	Working condition	Electrically
4	Number of operator	1 person/machine
5	Material input	Plant stem
7	Material output	Plant stem fiber
8	Maintenance system used	Oiling and cleaning
9	Power	2HP
10	Length of machine	0.75mtr
11	Width of machine	0.9mtr
12	Height of machine	1.1mtr
13	Driving type	Motor
S/N	Specification	Description

Table 1 shows multi fiber extraction machine description. The machine uses electric power and maintained easily by cleaning and oiling. The machine has 2HP motor. The cost to fabricate this machine is very cheap compared to Automatic Electrical fiber extraction machine in the market. To fabricate this machine, it costs only around 650$ as compared to 3500$ in case of an Automatic Electrical in the market.

IV. Conclusion

This project aims at facilitating innovative eco-friendly extraction, product development activities, and effective industrial utilization of fibrous wastes from plants stem. The project was set up to promote the creation of jobs, economic development and to create entrepreneur skill in students and will specialize in the production of extraction of fiber from different plant stem

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