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Design and Fabrication of Sisal Fiber Extraction Machine

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Abstract: In the past, the fibre was extracted manually by scraping away the pulpy matter with a blunt knife. Sometimes, leaves were cut longitudinally into thin ribbons and immersed in water till the pith matter was separated from the fibre. After retting, the fibre was washed and dried in the sun. Sometimes sisal leaves were boiled in water and beaten to remove the pithy matter from fibre, which was then washed and dried**.** The focus of the project is to design and fabricate a sisal fibre extracting machine which is operated by an electric motor to extract fibres from sisal leaf. Thus, the aim of the project is to develop a machine which yields good quality of fibre to increase the productivity and also to encourage small scale industries to use this machine instead of old-time consuming methods.

Keywords: Sisal, Fiber, Extraction, Electric motor.

I. INTRODUCTION

Many plants produce fibre from their fruits, seeds, stems and leaves, such as coir, cotton, kapok, hemp, ramie, flax, kenaf, jute, nettle, manila, abaca, bamboo and sisal. Sisal (Agave sisalana) is a fibrous plant, which is originated from Mexico (Chand and Rohatgi, 1994), but widely cultivated and naturalised in many other countries, such as Brazil, China, Kenya, Tanzania, Madagascar and Mozambique (FAO, 2013). The Sisal plant has a shallow root system that goes about 0.6 m deep and has 7-10 years life (Mwaikambo, 2006). Sisal is cut first time after 2-3 years and is subsequently cut after every 6-12 months. Sisal can be grown in wasteland, dryland and in saline soils and it can withstand severe drought conditions. Sisal fibre is mostly used in cordage industry due to its great strength, better spinning characteristics resistance to the action of saline water. Sisal fibre is considered a renewable resource with several environmental advantages over glass fibres, which is mostly used to make baler twines in agriculture. Other important traditional uses include making carpets, rugs, sacks, yarns, general and marine ropes and other domestic products. Sisal leaves are harvested manually using a sickle. A mature leaf attains a length of about 0.6 to 2.0 m. Cut leaves are decorticated the same day or within 48 hours to prevent their deterioration, if exposed to sun. The traditional method of extraction absolutely involves no machinery at all. This method was used in rural parts and the fibres extracted was used for some general purposes. This method involves cutting the leaves and soaking them in water for a minimum of 15 days. After 15 days the pulp on the leaf will get separated from the fibres present in it. The fibres are removed from the water and cleaned to remove any excess of pulp present on it. Then those fibres are used as ropes and other items. As this process is a time consuming one now a days it is not used. In southern part of America and Africa these fibres were extracted using Machine for commercial purposes, so large about of fibres were extracted. And tradition method was not an efficient method for this requirement hence fibre extraction machine is used. This machine consists of blade which squeezes out the pulp out of the leaf and fibre will be left out.

II. WORKING PRINCIPLE

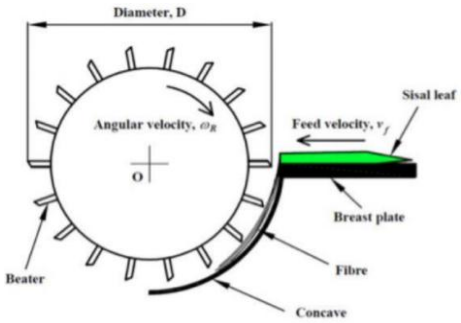

Fig 2.1

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The process of sisal fibre extraction can be explained as follows. Initially, the raw sisal leaf is given as feed to the machine. The blade will be rotating at a speed of 180rpm, at this speed when the leaf is fed, the pulp from the leaf gets squeezed against blade and the frame support. Then the leaf is pulled back forcing only the fibres to come out while the pulp removed remains in the blade. This process is repeated for several times until pulp is completely removed.

III. DESIGN AND FABRICATION

The Model is designed in CATIA V5 and is given appropriate dimensions to suit the expecting results. The model has mainly seven parts. They are: -

1. Frame
2. Blade
3. Driven pulley
4. Driver pulley
5. Pillow block bearing
6. Motor
7. V belt.

3.1 FRAME: It supports all the other parts and therefore should be sturdy and strong. It is the base for attaching Bearing and blades. It also holds the driven pulley. It is made up of Mild Steel Material. The material used here is ASME hollow rectangular pipe of 60 x 40 mm dimension made of mild steel. The height of the frame is 920mm from the floor. The Rectangular Frame at the top has a dimension of 600mm x 900mm.

3.2 BLADE: It is the main part of this machine. It does the work of removing pulp from the plant. It has eight cutting blades attached onto a hollow cylinder. This cylinder was cut at 400mm length and is having a diameter of 100mm. Blades were also cut at 400 mm length and are 8 in number. These blades have a 30 mm height and 5mm thickness. Now the entire outer diameter of the blade comes to 160mm Flange plates are welded on both sides of the hollow cylinder and holes are bore on the flange plates to allow the shaft to pass through it. The length of the shaft is 690 mm and shaft is turned suitably to accommodate the pulley and pass through the pillow blocks which different internal diameter. The blades were made blunt on one side using buffing process. The material used here is a hollow Mild steel for the cylinder and HSS for the blades.

Fig 3.1

3.3 DRIVEN PULLEY: It transmits power and torque from the driver pulley to the shaft through the belt. It is two belt type ,V-Belt pulley having an outer diameter of 16 inches. This driven pulley passes through the shaft and has key way to have a tight grip over the shaft

3.4 DRIVER PULLEY: This pulley is attached to the motor shaft. The power is transmitted from motor to the shaft with the help of these pulleys, which are connected with the help of two v-belts. It has an inner diameter of 3 inches.it also has a keyway slot machined in it to have firm grip over the motor shaft.

3.5 PILLOW BLOCK BEARING: It enables the Shaft to rotate and reduces the friction for rotation. It also supports the shaft on both the sides. They are attached to the frame and shaft of the blade passes through them. They have an inner diameter of 40 mm.

3.6 MOTOR: In this project we are using a 3phase 1hp motor. It rotates at a speed of 960 rpm. The motor is attached to the frame below the blade drum. Provisions are made for the motor to move front and back with the help of slots in order to tighten the belts.

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3.7 V BELT: In this project we are using belt for transmission of energy. V belt type is used and two such belts are used for this project. It runs the Driven Pulley taking the torque from the Driver pulley.

3.8 CHUTE FRAME: The chute frame comes attatched to the platform and provides support for the blades in removing the pulp from the leaves.It is made such that distance between the blade and the chute frame can be varied for a leaf of varying thickness

3.9 ASSEMBLY: The pillow blocks are first attached to the frame by welding. The Machined blade drum is inserted through the pillow blocks and tightened to hold the shaft firmly. Keyways are inserted into the shaft and the Driven pulley is hammered into the shaft for a firm grip. The motor with the height adjustment is attached to the frame. Driver Pulley is fixed to the motor shaft. Belt is put making use of adjustments. The assembly is done as shown in the figure, some height adjustments had to be done to make sure the belt is attached properly so that there are no chances of slippage during the operation. Platforms are made and welded to the top frame from where the leaves can be fed easily. Safety casing is provided for the blade drum which also prevents sputtering of the pulp.

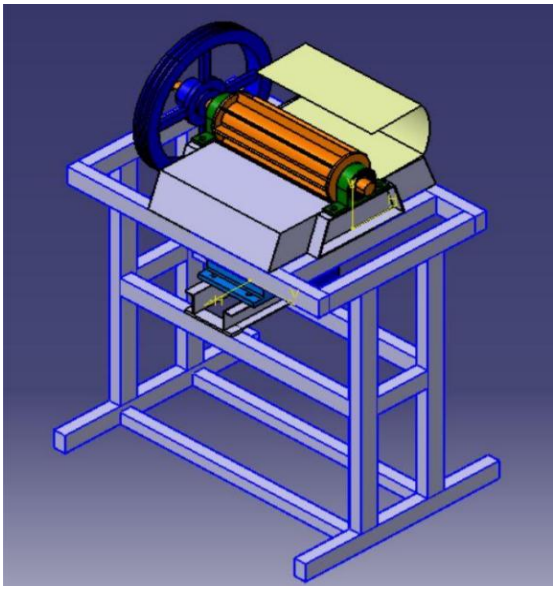

Fig 3.2

Fig 3.3

3.10 TESTING AND RESULT

After finishing the frame, we attached the motor to the frame. The electric motor was to be tested. We plugged in the motor and did our first test. We found that motor ran at 900rpm and the whole structure gave little vibrations and gave us a conclusion that we should not use swivel rollers at the bottom. After fixing the blade drum and pulleys, we bound a belt around the pulleys. Then we attached the half semi-circular chute frame, we did another test for the efficiency of the fibre extraction. We found that the machine was not giving satisfactory results.We then decided to go for a full semi-circular chute frame with a slit in the middle for the pulp to be removed. Before extracting the fibres from the machine, we wanted an example sample to compare the quality of the fibres extracted, so for that we decided to extract the fibres using manual technique. Here are some pictures that compare fibres obtained by manual and machine.

Fig 3.4 Manual

Fig 3.5 Machine

We can see that the quality of fibres is same.

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3.11 COST

The Project was made for an economical amount of Rs.24,000 and when compared to the industrial diesel motored extractor which is way costlier

Sl no	Part Name	Technical Specifications	Qty	Purchase cost
1	Motor	1Hp, 960rpm, 3 Phase	1	Rs. 3600.00
2	Drum pipe	100mm dia, 400mm length	1	Rs. 630.00
3	Flange plates	150 mm dia	2	Rs. 280.00
4	Blades	400 mm length, 30 mm width	8	Rs. 1024.00
5	Shaft	50mm dia, 690mm length	1	Rs. 800.00
6	Operating unit	2 ways, push button pendant	1	Rs. 600.00
7	Frame	RHS 60x40mm	-	Rs. 7500.00
8	Pillow blocks	40mm dia	2	Rs. 800.00
9	Pulley	4" inch and 16" inch	2	Rs. 1800.00
10	Belt	V-type, rubber	2	Rs. 400.00
11	Paint	Any choice	-	Rs. 1000.00
12	Hardware	As required	-	Rs. 500.00
13	Miscellaneous	-	-	Rs. 1000.00
14	Assembly Labour	-	-	Rs. 4000.00
		Total		**Rs. 24000.00**

Fig 3.5

IV. CONCLUSION

After planning and designing, we have successfully fabricated a model of sisal fibre extraction machine. We can see that the machine separates the fibre from the pulp effectively and we can get the sisal fibres as the output. Also, we have fabricated a model which does the work right and is both economic and optimized. These fibres as mentioned have a very good strength and these fibres are not yet used extensively in spite of having desired properties for rope making and other products. The sisal fibre products chain market is market which is yet to be tapped to its full potential. If industries recognise this, the demand for sisal products would increase encouraging farmers to grow more of this plant.

REFERENCES

[1]. V B Bhandari, "Design of machine elements", 4th edition, Tata McGraw Hill, 2016.
[2]. Design data hand book, K. Lingaiah, McGraw Hill, 2nd edition, 2003.
[3]. G. M. Maithra and L V Prasad, "Hand book of mechanical design", Tata McGraw Hill 2nd edition 2004
[4]. J N Reddy, "Finite Element Method", McGraw Hill international edition. Bathe K J . Finite element procedure. PHI
[5]. Rao S S, Finite element method in engineering, 5th edition, Pergman lnt. Library of science, 2010
[6]. "Design of machine element 2" by J B K Das.
[7]. Materials and Methods. Anna University Chennai.
[8]. Energy Conservation Drives for Efficient Extraction and Utilization of Banana Fibre. D.P. Ray, L.K. Nayak and Team. International Journal of Emerging Technology and Advanced Engineering Volume 3, Issue 8, August 2013.
[9]. Design and Development of Natural Plant Fibre Extracting Machine. Ganesh R, Lavanya G and team. Bapuji Institute of Engineering and Technology Davangere Project Reference No:40s_Be_0375