

# **BIODEGRADABLE SISAL FIBRE EXTRACTOR AND STUDY THE FIBRE QUALITY THROUGH VARIED SISAL LEAF SOCKING PERIODS**

**A K Murthy**

Professor, Dept. of ME, AMCEC, Bangalore, India

**Geetha T M**

Assistant Professor, Dept. of ME AMCEC, Bangalore, India

**Praneeth kumar S, Pavan kumar B N, Rajshekar, Nitin M Achari**

Students, ME, AMCEC, Bangalore, India

## **ABSTRACT**

*The demand of natural fibres is increasing in the world for industrial uses to make high value products.*

*An enormous potential of sisal fibre is used in making ropes, paper, carpets, cloth & handicrafts.*

*The aim of this study is to design & fabricate a small scale portable sisal fibre extractor for extracting fibre from sisal leaves.*

*However, hand processing of sisal leaves is a tedious, laborious & slow exercise resulting in low productivity & low quality fibre.*

*This machine has a great potential and needs to be commercialised in sisal growing areas of the country*

**Key words:** Sisal Fibre, Fibre Quality, Sisal, Leaf Socking.

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## **1. INTRODUCTION**

Knowing the huge potential of sisal fibres. Over a period of time, machines have been invented to extract fibres from the sisal leaves. However these machine successfully extract fibre from leaves but the major obstacle is that the machine is large in size, and applicable for large scale commercial purpose.

The cost of the machine is high and the area required for installation is more. To overcome all the above problems, we have designed and fabricated a small scale portable sisal fibre

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extractor. Which consists of a rectangular frame on which the entire setup is placed. To the one end of the rectangular frame four bolts of 12 inches of length are placed facing upwards. Two metal rollers are used. Universal hub bearings are connected to the ends of the rollers. The bearings with the rollers are bolted to the L shaped angle plates. Holes are drilled on the L shaped angle plate, measuring the distance between the bolts placed onto the rectangular frame. The L shaped angle plates are fitted into the bolts onto the rectangular frame and tightened with nuts. The distance between the two rollers can be increased or decreased by loosening or tightening the nuts.

A belt pulley of one feet diameter is fitted to the upper roller. To the other end of the rectangular frame a single phase induction motor of 2 HP is fitted. Both the rollers and the motor are connected through v belt.

When the motor is connected to the power supply. The motor (driver) rotates the roller (driver). The upper roller rotates in clockwise direction and the lower roller remains constant. 2mm of gap is maintained between the two rollers.

The leaves are fed in between the two rollers and the leaves gets crushed and comes out from the other side which is collected and further washed in clean water, dried in sun and combed to extract fibres.

However the machine designed and developed is a semi-automated and applicable only for small scale purpose.

Mild steel is used for the fabrication of the entire machine.



**Figure 1**

### LEAF SPECIFICATION

- Length : 550mm to 1600mm
- Width : 45mm to 120mm
- Weight : 0.27kg to 0.75kg
- Thickness : 2mm to 40mm
- Colour : green

## 2. OBJECTIVE

To design & fabricate a suitable machine for extracting fibers from sisal leaves.

To study the process ability of the machine and successfully extract the fibers without damaging their essential properties.

To analyse the structure & properties of extracted fibers.

To analyse the suitability of the extracted fibers for various applications.

### 3. CONCEPTUAL SKETCHES

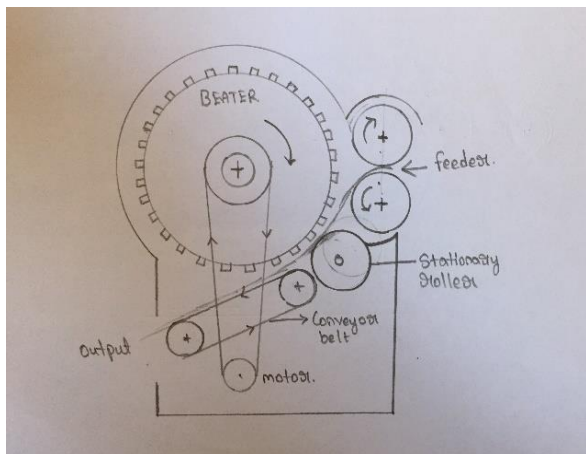


Figure (a)

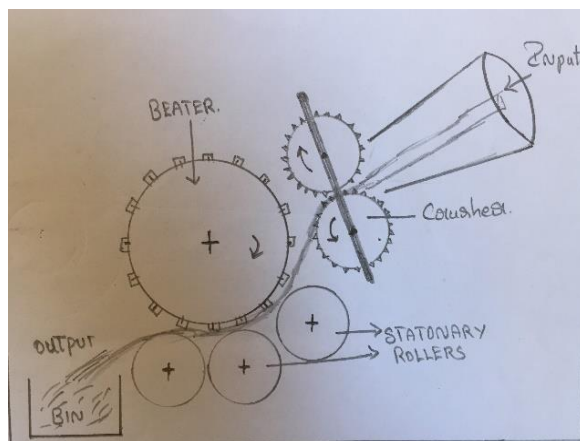


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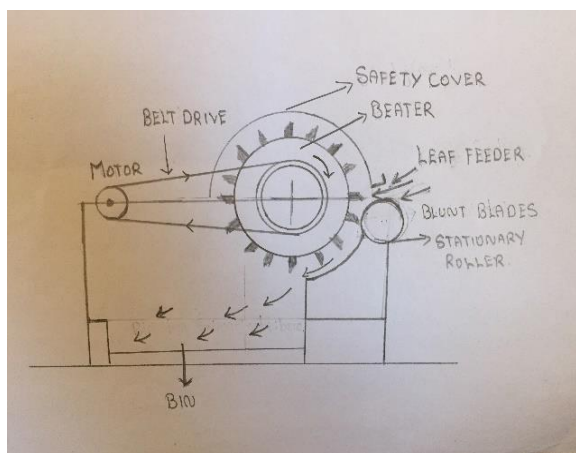


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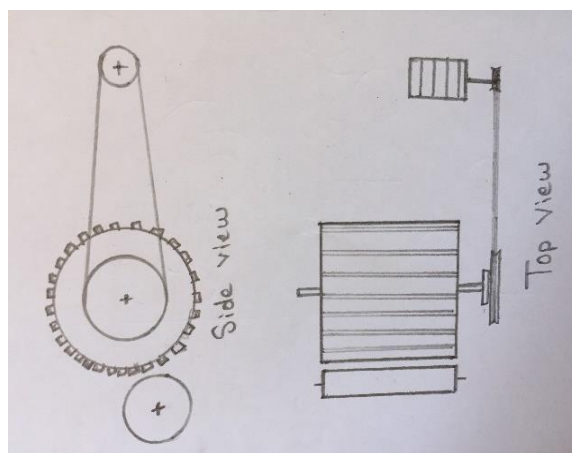


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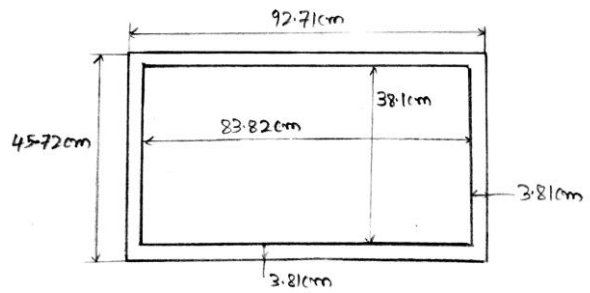
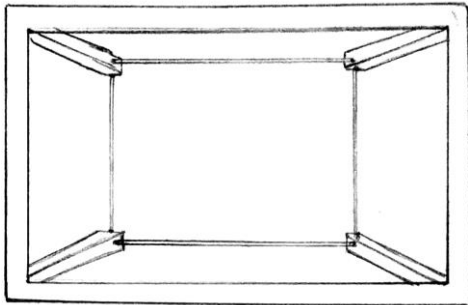
### 4. METHODOLOGY

Sisal leaf is fed in between the two rotating rollers, rotating in opposite direction. 2mm of gap is maintained between 2rollers. The leaf has a varying thickness, the tip of the leaf is 2mm and goes on increasing until the butt. The leaf gets crushed when it comes in contact between the 2rollers and the pulp material gets separated from the leaf. The fibres are collected from other side of the rollers. Then the obtained fibres are washed in clean water to remove the remaining residue on the fibres, dried in sun and combed to obtain good quality fibres

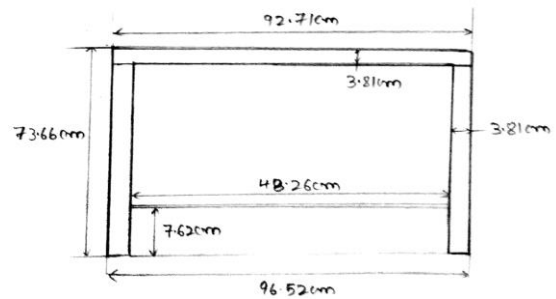
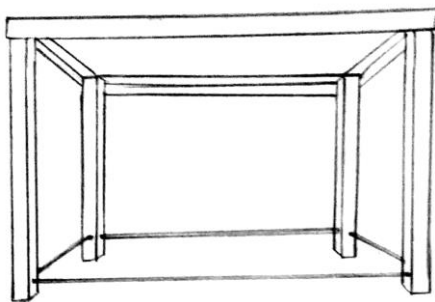
## 5. FABRICATION

### Frame

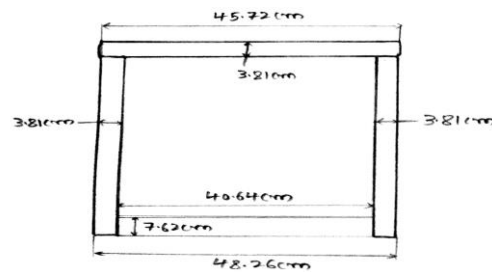
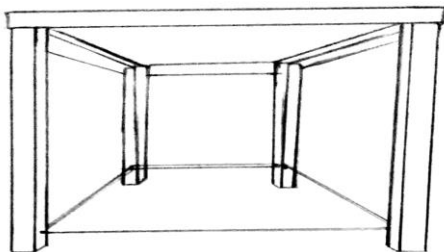
#### Top view



#### Front View



#### Side view



length : 920mm /width : 450mm

height : 730mm



Figure 2



Figure 3



**Figure 4**



**Figure 5**



**Figure 6**

## **6. MACHINE COMPONENTS**

### **Bearings**



**Figure 7**

materials made : cast iron housing , chrome steel bearing

Housing width : 38mm

Inner dia : 20mm

Bearing type : Extended inner race with set screw

## Pully



**Figure 8**

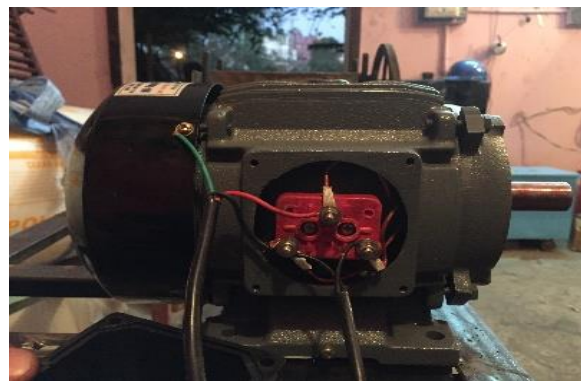
BIG Outer dia : 305mm

Inner dia : 20mm

SMALL Outer dia : 76mm

Inner dia : 20mm

## Motor



**Figure 9**

3phase induction motor

2hp

440 volts

1480 rpm

## Belt

Type : v-belt

B series 71

## 7. ASSEMBLY AND WORKING PRINCIPLE

Sisal fibre extractor fabricated is one of the unique type where the entire machine can be dismantled. The working parts are setup on the rectangular frame. To the top left end of the frame two rollers are placed whose ends are connected to the universal hub bearings and held together by the bolts. Where the gap between the two rollers can be increased or decreased by loosening or tightening the nuts. Pulley is connected to the top roller and the lower roller. To the top right of the rectangular frame an electric motor is fixed and a v belt is connected from

the motor to the upper pulley. To the bottom right of the rectangular frame another electric motor is fixed and a v belt is connected from the electric motor to the lower pulley.

Both the motors run in clock wise direction when connected to the power supply.

### Working principle

When both the motors are connected to the power supply. They rotate in clockwise direction. As the v belts are connected to the two rollers both the rollers rotate in opposite direction to each other. Maintaining the gap of 2 mm in between the rollers, leaf gets easily crushed and fibres from the leaf gets separated from the pulp material.



Figure 10

### SISAL PLANT



Figure 11



Figure 12



Figure 13

## Biodegradable Sisal Fibre Extractor and Study the Fibre Quality Through Varied Sisal Leaf Socking Periods

Many plants are grown for their flowers and fruits. But there is a plant named sisal which is grown for its high fibre content. Sisal belongs to a family of asparagaceae. Sisal is also called by another name agave sisalana. Sisal found its origin in southern Mexico but it is largely cultivated in many other countries such as Brazil, china, Kenya, Madagascar etc...

Sisal plant was grown for the purpose of fencing and burnt as fire wood, before the people knew the fibre that can be extracted from the plant. The sisal plant has a life span of 7 to 10 years and produces 200 to 250 leaves. Sisal gets harvested for the first time after 2 to 3 years of plantation but subsequently harvested after 6 to 12 months.

Sisal is a plant which can be grown in wasteland, dry land and in saline soil and it has a special quality of withstanding severe drought conditions. In India, sisal is mainly found in Orissa, Maharashtra and southern states. Approximately 1000 tonnes of sisal is produced in India every year.

### CHEMICAL COMPOSITION OF SISAL FIBER MACHINING PROCESS[1]

COMPOSITION	AMOUNT (%)
Cellulose	68-80
Hemicellulose	15
Lignin	5-17
Wax	0.26
Moisture	8

### COMPARISON OF MECHANICAL PROPERTIES BETWEEN TEXTILE FIBRES[1]

Fibres	Tenacity (cN/text)	Strain (%)	Initial Modulus (N/text)	Work fracture (mN/text)
Agave Americana	21-41	2-4	0.2-1.45	7.7-25.4
Sisal	40-49	2-3	25-26	-
Flax	25-26	2.7-3.3	18	8
Jute	29-56	1.2-1.9	17.2	2.7
Cotton	28-48	3-10	5	10.7
E glass	82	2.5	29.4	9.8
Polyester (HP)	61	7	13.2	22

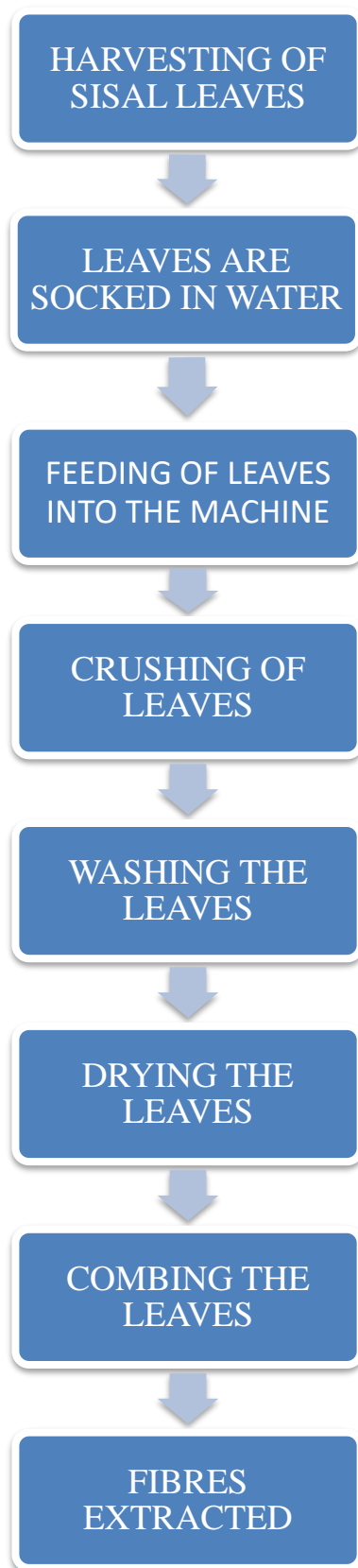
### Production Scenario

Sisal is mainly grown in arid and semi-arid regions of Andhra Pradesh, Bihar, Orissa, Karnataka, Maharashtra and West Bengal. About 275 species are distributed in tropical regions of India. The major sisal cultivation districts of different states in India are given below.[4]

State Name	District
Karnataka	Chamraj nagar
Tamilnadu	Vellore
Uttarakhand	Kumaon, kotdwar
Madhya Pradesh	Durg, Bhopal
Maharastra	Ahemadnagar
West Bengal	Midnapur(E)
Jammu & Kashmir	Bhalwal, Jammu, ratnapur sarar, kathua



## 8. FIBRE EXTRACTION PROCESS



## Biodegradable Sisal Fibre Extractor and Study the Fibre Quality Through Varied Sisal Leaf Socking Periods

The sisal leaves are soaked in water for 10 days. The purpose of soaking the leaf is that the pithy matter which is present in the leaf gets separated and the process for the extraction of fibre gets easier. The soaked leaf is fed into the machine.

The machine consists of two main roller, bearings are connected to the ends of the rollers. The rollers are held together by the bolts and fixed to one end of the rectangular frame.

Motor is fixed to the other end of the rectangular frame, v belt is connected between the two pulley. The larger pulley is fixed to the roller and the smaller pulley is fixed to the motor.

Leaf is fed in between the two rollers which rotate in opposite direction and gets crushed, the green leaf material gets removed and the fibre gets extracted.

The extracted fibre is washed in water and dried in sun.

### 9. FIBRE EXTRACTED



Figure 14



Figure 15



Figure 16

### 10. OBJECTIVE OF THE STUDY

- To study the obtained fiber quality under various conditions.
- To study the performance of the extractor.
- To use the extracted fibre for various application.

### 11. STUDYING THE PERFORMANCE

Knowing the performance of the machine can help us in future study and improvement or betterment of the machine.

Firstly, the leaves are cut from the sisal plant and directly fed into the extractor and the percentage of the fibre successfully extracted is noted.

Then the fresh leaves are soaked in water for five days and then fed into the extractor, then the percentage of the fibre extracted is noted. In the same way the leaves are soaked for 10, 15 & 20 days and fibres are extracted and the percentage of the fibres are noted down.

The more percentage of the fibre obtained for so many number of days of soaking will be followed in the future.

## COMPARISON

Sl No	No. of days leaf soaked in water	% of fibre obtained	Quality of the fibre	Image
1	0	5%	Not good	
2	5	30%	Ok	
3	10	55%	Moderate	
4	15	70%	good	
5	20	80%	Good	

## OUTCOME

- A small scale portable sisal fibre extractor has been fabricated.
- Fibres has been extracted from the machine fabricated.
- The machine can be easily transportable as the weight is below 100kg and the space required for installation is very minimal.

## POSSIBLE APPLICATION

The fibres extracted can be used for making,

- Cordage such as rope, twine, and yarn.
- Composite materials such as automobile components, construction roofing and paneling materials.
- Woven materials such as carpets, bags and buffing cloth ect..
- Organic fertilizer, animal feed stock, industrial alcohol (ethanol), pharmaceutical products (insulin), pulp and paper (speciality paper, reinforcement) and energy generation (biogas, electricity) [4]

## 12. LITERATURE REVIEW

Title	Authors	Year
Design and development of portable sisal decorticator	Tanveer Ahmad, Sultan Mahmood, Zulfiqar ali, Muhammad Azeem Khan	2017
Design and development of plantain fibre extraction machine	B.U.Oreko, S.Okiy, E.Emagbetere, and M.Okwu	2018
Studies on physical properties of sisal plant leaves	Naik R.K, Dash R.C, Behera D and Goel A.K	2016
Portable sisal decorticator for Kenyan formers	Benjamin J. Snyder, Jeo Bussard, Jim Dolak, Timweiser	2006

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