

Development of Sugarcane Peeling Machine

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Abstract: India is an agricultural country. The cultivation of extensive range of agricultural crops makes sugarcane one of the most significant output crops in India. Sugarcane is commonly referred to as the source of grain of sugar for daily use. Sugarcane has many uses such as medical treatment, food additive and act as a quick burst of energy. In order to get the sugarcane juice, peeling process plays a fundamental role. This process removes the dirt, dust, black spots and other impurities present on the outer layer of the sugarcane. The purpose of this research is to design and manufacture the sugarcane peeling machine. In order to solve the problem that appeared in hand peeling sugarcane, the sugarcane peeling machine is designed. This machine includes electric motor, bearing, peeling blades, gears and chain drive. This paper aims to reduce the total time required due to manual peeling and reduction in operator fatigue due to tiresome peeling operation. The time required to manually peel the sugarcane of length 50 cm is 90 sec and the time required to peel the sugarcane of length 50 cm by sugarcane peeling machine is 20 sec. The proposed machine is expected to peel the sugarcane at a faster rate without much fatigue.

Keywords: Sugarcane, peeling, sugarcane juice, agricultural crop, fatigue

I. INTRODUCTION

One of the best-known industrial crops in the world is sugarcane which is effectively produced and harvested to create both food and bio-energy. Depending on the taxonomical system, sugarcane is one out of 6 to 37 species in large, long-term grasses. It is a tropical grass in the same family as sorghum, Johnson grass and maize. Sugarcane is a multipurpose crop that serves as source of sugar, juices, jiggery and various products. Fresh sugarcane juice is a popular beverage in many countries particularly in India. The largest sugarcane producing state in India is Uttar Pradesh, which has a 38.61% share in overall sugarcane production. Maharashtra and Karnataka are the second and third largest producers. Bihar, Assam, Haryana, Gujarat, Andhra Pradesh and Tamil Nadu also are the largest producers. The sugarcane juice is served in many eateries from roadside stalls to five-star hotel dining halls.

Before extracting the juice from sugarcane, peeling is done. The first step from harvest to processing is peeling, which is a crucial process. Numerous studies and researches have explored the process of sugarcane peeling. During harvest, sugarcane stems are removed from the field. One of the products that can help the nation's economy is sugarcane. Currently, sugarcane stalks are utilized as a raw material in a variety of other industries, including the chemical industry, animal feed, pharmaceuticals, the mushroom business and fertilizers. To develop a stock of sugar raw materials and increase the economic well-being of sugarcane producers, sugarcane planting is advised.

Peeling is a process in which the upper layer of sugarcane is removed along with black spots, mud and other impurities such as dust and dirt. If the sugarcane or the sugarcane juice is consumed with these impurities it will have adverse effect on human health. The process of peeling the sugarcane increases the quality of sugarcane juice. The amount of sugar in sugarcane juice varies depending on the type, age, environment and management practices of the sugarcane as well as other chemicals (non-sugar compounds).



Fig 1: Manual Peeling of sugarcane

Manual peeling of sugarcane is time consuming and causes labour fatigue. There may be a risk of injury to the labors performing the peeling operation with the blades or knives manually. All this problem can be eliminated by producing the machine which can be operate automatically to reduce human efforts and time. Our aim is to produce automatic sugarcane peeling machine which will be cost effective and will eliminate the problems of manually operated sugarcane peeling machine.

II. LITERATURE REVIEW

Prof.S.J.kadam Sarita Sutar, Prathamesh Shinde, Kiran Shelke, Amrapali Patil, “Design and Fabrication of Sugarcane Peeling Machine” 10th March 2018

India is an agricultural country. The cultivation of a wide range of agricultural crops makes sugarcane one of the most significant output crops in India. In this project, the idea of a sugarcane peeling attachment is covered. Many small-scale sugarcane juice production facilities require manual sugarcane cleaning. Since the sugar cane must first be cleaned before being fed into the machine for juice extraction, this procedure takes time and is tiresome. The goal of this project is to create a sugarcane peeling attachment that, when used, can help peel sugarcane automatically. The goal of this project is to cut down on the overall time needed for manual peeling as well as operator fatigue brought on by the strenuous peeling process.

GeXinfeng, “Design of Sugarcane Peeling Machine”, AJFSAT, February 25, 2015

The sugarcane peeling machine was created to address the issue that cropped up when peeling sugarcane by hand. It consists of a motor, groove wheel, cutting area, slider crank mechanism, reducer (including belt drive and chain drive), and other components. A simulation of the sugarcane peeling device that was designed, the Results indicate that the sugarcane peeling machine can successfully peel sugarcane in a convenient, quick, and uniform manner.

El-Yamani, A. E. and M. A. Basiouny, “Performance Evaluation of New Sugarcane Peeling Machine Prototype”, Vol. 7, 2016

The goal of the current inquiry was to design and assess the functionality of a novel small-scale sugarcane peeler equipment. Real-world tests were conducted on the created machine prototype during the 2014–2015 growing season at a sugarcane private store in Kafrel sheikh province. The studies showed the results of the primary design and operating parameters, on the effectiveness of the machinery and the calibre of the final product. Three separate parameters were examined in the study. There are three different types of peeling drum brushes: zigzag and spiral. There are four peeling drum. Three feeding are combined with peeling drum. The created device efficiency of the machine's production, the effectiveness of peeling cane stalks, and peel retention on peeled.

Rita Maria Veranika, Madagascar, Selvia Aprilyanti, Tine Aprianti, “The Manufacture of Sugarcane Peeler and Squeezer”, AUSTENIT Vol. 14, April 2022

The purpose of this research is to design and manufacture a sugarcane squeezer machine using a combustion engine. The implementation method in the manufacture of this machine uses a propulsion system including combustion motors, pulleys, v-belts, gears, shafts, pegs, rollers and bearings. The results obtained from the design and manufacture of this sugarcane squeezer machine are that the energy and time that have been used are more efficient and the sugarcane processing is faster than manually. The design specifications of the tool are 0.5Hp engine capacity, 220 volt voltage and 2500 rpm rotation.

Sreedevi Pandraju, Madhava M, Amith Padhi, “Development of low cost sugarcane peeler for small vending’s”, The Pharma innovation Journal 2021; SP-10(3): 248-253

Low cost peeling machine for sugarcane was developed for small scale vendors. The performance of the machine was evaluated for peeling efficiency, machine production efficiency, cane stalk weight loss, power consumption and speed and the results were compared with manual peeling. After peeling operation, juice was extracted from peeled canes and quality of the juice was compared with manually peeled canes. The output capacity of mechanical peeler was achieved as 109.6 kg/h with machine production efficiency of 75.4%. Percentage of labour and time saving of mechanical sugarcane peeler over the manual peeling was 66.6% and 164% respectively.

III. PROBLEM STATEMENT

There is a formation of bacteria and black spots on the outer layer of sugarcane during off seasons particularly in rainy and winter seasons. Also the outer layer of sugarcane contains the impurities such as dirt, dust, mud, etc. Most sugarcane juice are sold on a small business with a conventional manual peeling machine to peel the sugarcane before extracting the juice. The manual process of sugarcane peeling is time consuming. It requires lot of time to remove the outer layer of sugarcane. Manual peeling can lead to so much wastage of useful sugarcane flesh and also uneven removal of outer layer of sugarcane by manual peeling process causes too much wastage. Manual operation requires lot of human strength. Also there may be a risk of injury to the labour performing the peeling operation. If the sugarcane is not peeled, nutritious juice cannot be extracted and quality of juice will be low because of the impurities present on it. When the sugarcane is put in the juice extracting machine for extraction of juice without peeling the sugarcane, the hard nodes of the sugarcane may cause damage to the juice extracting machine and hence the performance and efficiency of the machine will be reduced.

IV. CONSTRUCTION AND WORKING

As shown in figure, the sugarcane peeling machine consists blades, bearing, sprocket and chain drive and electric motor. 8 blades are used to carry out peeling process. Bearing is used to transmit power and to reduce friction by means of rolling motion. Sprockets are sturdy wheels that lock onto a chain and move other parts that interlocked with the chain. They are used to transmit rotary motion by engaging with chain. An electric motor is used to convert electrical energy into mechanical energy, providing a power source for machine.

By pressing the start button, the motor starts running. The shaft on the motor rotates and simultaneously the smaller sprocket rotates which is mounted on the same shaft. The holes in the chain links fit over the sprocket teeth. With the help of drive chain the power is conveyed, by passing it through a sprocket gear and the teeth of gear mesh in holes of chain link. The sprocket gear is then turned which results in pulling the chain providing mechanical force to the system. The bearing rotates and the larger sprocket mounted on it also rotates. The blades rotate. The sugarcane is inserted from the inlet into the sugarcane peeling machine. The rotating blades peel the sugarcane and the peeled sugarcane comes out from the outlet

V. MATERIALS

Sr. No.	Components	Material
01	Blades	Low alloy Steel (mixture of magnesium, chromium, silicon along with 0.5% carbon or pure iron)
02	Bearing	High carbon chromium steel
03	Stand	Mild Steel
04	Chain	Plain carbon steel
05	Sprocket	High carbon steel

VI. SPECIFICATIONS

Sr. No.	Components	Specification
01	Motor	0.12 HP, 1200 RPM
02	Bigger Sprocket	44 Teeth
03	Smaller Sprocket	14 Teeth



Figure 2. Front view of sugarcane peeling machine



Figure 3. Side View of Sugarcane Peeling Machine



Figure 4. Top View of Sugarcane Peeling Machine



Figure 5. Peeling section



Figure 6. Electric motor

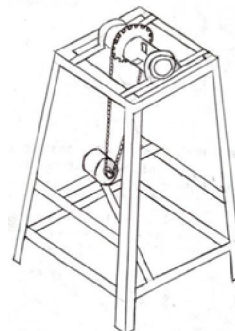


Figure 7. Schematic view of sugarcane peeling machine

VII. CALCULATIONS

Current, I = 0.46A (calculated using Ammeter) Supply Voltage, V = 230V

Speed of Motor = 1200RPM (calculated using Tachometer) Power,

$$P = V \times I$$

$$P = 105.8 \text{ W}$$

Horsepower = 0.14182 hp

To calculate number of poles of motor,

$$F = \frac{P \times N}{120}$$

Where, F = frequency = 50Hz

N = Relative speed = 1200 RPM

P = Number of Poles for a rotor speed N

$$P = \frac{F \times 120}{N}$$

No. of Poles = 5

$$\text{Torque on motor} = \frac{\text{Power in HP} \times 9550}{\text{Speed in RPM}} = 1.1286 \text{ Nm}$$

Power Required = Torque × Angular Velocity

$$= T \times \omega$$

$$= T \times \frac{2\pi N}{60}$$

Power Required = 141.82 Watts

Time required to peel the sugarcane of length 50cm is 20sec.

VIII. RESULT AND DISCUSSION

The length of the sugarcane varies from 220 to 255 cm and the diameter of cane varies from 20 to 34mm. The comparison between the manual peeling process and sugarcane peeling machine is obtained. The time required to manually peel the sugarcane of length 50cm is 90sec and the time required to peel the sugarcane of length 50cm by sugarcane peeling machine is 20sec. In 1hr (i.e. 3600sec) 180 pieces of sugarcane of length 50cm can be peeled. The specifications of developed sugarcane peeler was measured and presented in the following table.

Parameter	Details (machine)
Overall Height	86cm
Overall Length	54cm
Overall Width	54cm
Peeling Mechanism	Blade Type
Power Source	0.14Hp
Speed of Motor	1200RPM
No. of Blades	08

IX. CONCLUSION

It can be concluded that the sugarcane peeling machine using 0.2HP electric motor and 8 blades peel the sugarcane at faster rate than peeling it manually. The objective to design and fabricate a machine to shorten the time required to peel

the sugarcane manually is achieved. Also the problems which were arise due to manual peeling like labour fatigue, time consumption, risk of injury to labours, unhygienic sugarcane, etc. is eliminated to a great extent. The overall performance of the machine is quite efficient. The maintenance cost of the machine is relatively cheaper. The hygienic peeled sugarcane without dirt, dust, bacteria and black spots is got which can be further used to extract the juice.

ACKNOWLEDGEMENT

We would like to take this opportunity to express our deepest gratitude and whole hearted thanks to our college Bapurao Deshmukh College of Engineering, Sevagram. Wardha, Maharashtra.

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