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Review on Design, Development and Analysis of Flywheel Operated Manual Sugar Cane Juice Making Machine

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Abstract: This work entails developing a device for extracting sugarcane juice. The operator of a sugarcane juice machine of the past had to rely solely on his hands, leaving his legs dormant while he stood to do his work. Therefore, we update the sugarcane mill with some modern features. Machine parts include a pulley, a v-belt, a flywheel, a rotor made of cast iron, bearings, a pedal, and a body frame. The sugarcane machine has been modified so that the operator can use their legs to pedal instead of their hands. By using a flywheel to ensure continuous rotation, we are able to solve the problem of vibration and shocks.

Keyword: Pulley, V-Belt, Flywheel, Cast Iron Rotor, Bearings And Pedal With Body Frame

I. INTRODUCTION

Sugarcane milling is an essential and required unit process for producing high-quality sugarcane juice. The present sugarcane juice extractor available on the market is energy intensive and makes use of a complex mechanically powered extraction process. To make matters worse, some of the juice extractors on the market are too expensive for the small-scale, rural entrepreneurs who wish to open a sugarcane juice business.

Miniature machines powered by a flywheel or pedals are used to crush sugarcane for sugarcane juice. This device has to be portable enough to be transported with little effort. There is no requirement for electricity to power this device. Crushing sugarcane using this equipment requires just a single worker. This equipment is less expensive to purchase in rural areas.

The pedal makes it simple to provide additional loads to crush the sugarcane, thus a sugarcane juice machine that is powered by a flywheel and human effort may reduce the amount of time spent cutting cane. This machine can be used by anybody without the requirement for special training or a substantial quantity of power. Small farm sizes and farm dispersion due to load ownership via inheritance are issues in sugarcane processing. Inadequate methods and spaces for preserving harvested canes and extracted juice before processing them into sugar (Mello and Harries, 2000, Wegener, 1996).

When compared to conveying harvested sugarcane to the factory for processing into sugar, the production cost of moving extracted sugarcane juice from the farm to the factory for refining into sugar is lower while utilising the same carriage capacity medium, as shown above.

These are the main steps in transforming sugarcane into its valuable byproducts. That sugarcane processing begins with squeezing juice out of the stalk was made very evident. Several different techniques for obtaining the juice were utilised. Boiling the cane to extract the juice is one technique, as is using a wooden procedure, and using more advanced means powered mechanically or by bullocks. One of the main obstacles to the creation of smaller sugar processing facilities is the large amount of electricity needed to process sugarcane. This is also the reason why pure sugar juice is hard to come by. At a crushing rate of 170 tonnes per hour, this diagram depicts the typical power distribution in a medium-sized sugar plant that uses electricity or steam turbines for propulsion. In order to accommodate the demands of small-scale farmers who are unable to forego the use of high-capacity, sophisticated cane crushers, the small-scale sugarcane juice extractor was developed. The primary goal of the research was to develop and fabricate a simple mechanical system for obtaining sugarcane juice. Its operational efficiency and cost-effectiveness were assessed. The agricultural industry plays a key role in the Indian economy. For almost two-thirds of India's workforce, horticulture is their sole source of income. Farmers tend to a wide variety of plants.

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Among these are oil seeds, food crops, crops that are in high demand, and others. For example, sugarcane is a high-demand crop that is widely cultivated in India. In both Asia and Europe, sugarcane is the primary source of sugar. Most sugarcane fields are located in the subtropical and equatorial regions of the southern hemisphere. Cane sugar, jiggery, and khandsari all start as sugarcane. You may also get juice from it by chewing it. By helping to mobilise rural resources and provide greater income and job possibilities, India's sugarcane agriculture and sugar business is an important contributor to the country's socioeconomic growth in rural regions. At initially, to help out the farmer, a basic hand-operated cutter was utilised. According to historical accounts, sugarcane's widespread usage and global dissemination date back to antiquity. Cutting is accomplished on small farms by pounding the sprout with a hand or foot mallet. This sugarcane cutter is handled by hand and features a small blade to efficiently trim sugarcane shoots. This device has to be portable enough to be transported with little effort. There is no requirement for electricity to power these devices. The sugarcane shoots may be chopped with ease by a single operator using this equipment. This equipment is less expensive to purchase in rural areas.

II. LITERATURE REVIEW

1. Mr. Lende A. (2013) The majority of India's population, almost 60%, resides in rural regions, where basic services like power and job opportunities are scarce. The nation is still struggling to meet the most basic requirements of its citizens. A nation with a large rural population should prioritise research in areas that make the most efficient use of the available human resources. For the purpose of powering the process unit, the authors of this research have presumably previously created a pedal-operated human-powered flywheel motor.

2. Mr. Ghuge V.,Mr. Modak J. (2014) The growing pollution caused by burning fossil fuels is threatening ecological sustainability. Human power is being studied as a potential source of renewable energy. This study uses mathematical modelling to predict how long it would take for a human-powered flywheel motor to completely deplete its stored energy.

3. Mr. Mali p.(2015) Since there are so many practical methods for threshing corn in India. The difficulty is that farmers with smaller area farms cannot afford such large threshing machines because of their prohibitive cost. The high expense of these machines prevents a lot of Indian farmers from using them. Therefore, these farmers turn to hand-operated instruments, notwithstanding their poor production, increased damage to the kernel threshold, and repetitive nature. Although the introduction of mechanised maize threshing has made life easier for farmers, this advancement has not been accompanied by any corresponding improvements in efficiency, safety, or cost-cutting. These machines have a straightforward mechanical layout, making it possible to set up a man-machine system. In this assessment of the available literature on human-powered machines, we find evidence of a system that is both cost-effective and functionally practical.

4. Mr. Patil Sir , Nikhil Nangare(2016) Every need in the modern world is met by an automated mechanism. There's a need to cut down on sugarcane waste. This concludes our project's quest for an automated system. Budchips, or plant removed auxiliary buds of cane stalk, are a viable alternative to conventional seed cans in terms of both bulk reduction and seed quality improvement. These bud chips are a convenient, lightweight, and cost-effective alternative to whole seeds. New cane kinds might be produced at a quick rate using the bud chips technique, which offers a lot of potential. Applying plant growth regulators and necessary nutrients might solve the issue of establishment and early development.

5. Mr. Moghe S. (2016) In the current study, the investigator pedals a stationary machine to generate mechanical energy, which is then transmitted through a crank chain and a free wheel to the working unit. The notion of the human-powered flywheel motor ushers in a brand-new era for manually operated agricultural machinery. Thinking about people. There are numerous rural activities that rely on untrained workers, and electricity is more of a concern in the vidharbha area, thus the HPEM idea is useful in powering a wide range of rural machines. The machine is cost-effective and may be included into human-powered process units that experience intermittent operation without compromising the quality of the final output.

Santosh Y. Salunkhe(2015), The sugar business would collapse without the three roller sugar mill. Juice containing sucrose is extracted from the cane using a sugar roller mill, which has three rollers: a top roller, a feed roller, and a discharge roller. The mill works by compressing the ready cane between a pair of rollers, squeezing out the juice. The stress analysis is performed using a numerical technique called finite element analysis (FEA). To do this, the component's solid model is broken down into smaller parts, and then constraints and loads are applied to each of those elements. In order to make the 3D Geometrical model, we need the programme Pro-E. Study software ANSYS Workbench is being used to do the static structural analysis of the roller shaft. Maximum shear stress is computed analytically for the Top, Feed, and Discharge rollers and compared to the software findings. All three rollers are analysed statically, with forged steel used in the study.

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III. METHODOLOGY

As a nutritional supplement, people prefer sugarcane juice. At the roadside stall, the sugarcane juice machine, which typically requires the customer to mix the drink by hand, is always a popular stop. This apparatus is used to extract juice from fruits and vegetables, and it is equipped with a roller and a gear system. It may be operated manually or with an engine.

Milling the sugarcane is the first and most important stage in the process of producing the sugarcane juice that will be used in other industries. The sugarcane juice extractor that is now available on the market is one that consumes a lot of energy and makes use of complicated mechanical mechanisms. If someone wants to start their own sugarcane juice company but operates on a smaller scale or lives in a more rural area, they may not be able to purchase some of the existing juice extractors because they are either too costly or need too much manual labour to extract the juice. Sugarcane juice machines are often pedal-driven or propelled by a flywheel, and they are small, portable, and simple to carry. These devices extract juice from crushed sugarcane. This device has to be portable so that it can be moved about easily. This gadget can function quite well without being powered by electricity. One person is all that is required to operate this machinery and crush the sugarcane. In more rural areas, the cost of this equipment is less than what one may expect. Therefore, a sugarcane juice machine that is driven by a flywheel and human pedalling may minimise the amount of time spent cutting cane. The pedal makes it easy to deliver extra weights to crush the sugarcane. Anyone can use this machine without the need for specialised training or a significant amount of physical strength since it does not need either of those things.

The inheritance of loads causes one of the problems that arises during the processing of sugarcane, and that problem is the fragmentation of fields into numerous smaller activities. Canes that have been harvested and juice that has been extracted are unable to be turned into sugar because insufficient procedures and facilities are used to preserve them. Not only do we face the challenges mentioned above, but when compared to transporting harvested sugarcane to the factory for processing, transporting extracted sugarcane juice from the farm to the factory for refining into sugar would lower production costs even more while utilising the same carriage capacity medium. This would be the case even if we kept the same medium for transporting goods. The major processes that are utilised to convert sugarcane into goods that may be put to good use. It was made abundantly clear that the initial phase in the sugarcane processing chain consisted of extracting juice from sugarcane stalks by means of squeezing. There were a number different approaches used in order to extract the juice. One method for extracting the juice from the cane is to boil it, while other methods include utilising a wooden process, using more complex ways driven mechanically or by bullocks, and boiling the cane. The huge amounts of electricity that are required during the processing of sugarcane provide a barrier to the development of smaller-scale sugar processing plants. Therefore, this is the reason why natural sugar juice cannot be purchased in stores. The distribution of power in a typical sugar mill, assuming a crushing rate of 170 tonnes per hour and using either electrical turbines or steam turbines as the source of power. The small-scale sugarcane juice extractor was created in response to the needs of small-scale farmers who were unable to avoid using large capacity and sophisticated cane crushers. This was done in order to meet the expectations of these farmers. The development and construction of a straightforward mechanical technique for extracting sugarcane juice was the major objective of this line of study. The operating efficiency of the machine as well as its cost were evaluated..

IV. DESIGN ANALYSIS

A. Analytical method The various terms relating to the sugarcane mill rollers used as per the following: -

a. Shaft- A round forged steel bar on which the cast iron shell is fitted.

b. Roller journal – The polished surface of both the ends of shell- seat on which the bearings are fitted. It looks like a knurling surface.

c. Pintle end- The shaft ends having a key-way for the sprocket- fitting is known as Pintle end.

d. Square end- The shafts end on which pinion and coupling are fitted.

e. Shell – It is a hollow cast-iron round which is shrunk - fitted on the shaft.

f. The roller shaft is an important item of the sugar mill equipment and being subjected to heavy loading and it must be made to high standard of quality.[7]

Where, Shaft Material- 45C8 (C - 0.35-0.45 %, Mn - 0.60 to 0.90%) Density- 7850 Kg/m³.

E - Modulus of Elasticity = 210 Gpa. Poisson's ratio = 0.31 Syt - yield strength in tension - 380 Mpa Sut - ultimate tensile strength - 710Mpa Se - Endurance limit = 23 Kg/mm2 Kf - Stress concentration factor =1.

B. Design analysis of Roller Let the force failure be - 110 N Force = 110×2 = 220 N

Let the mass of sugarcane be =130 or 150 kg F=mω2r 220 =0.13×(2π×1400÷60)2×r r = 0.669 m Día=0.133m =133 mm = 150mm

C. Design analysis of shaft Shaft Material- 45C8 (C - 0.35-0.45 %, Mn - 0.60 to 0.90%) Where, Input data:- L1=550mm L2=400 mm L3=400 mm

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D- Roller Dia. OD. = 150 mm HP- Mill power for drive = 1 HP. N- rpm of roller shaft = 10 rpm Shaft dia. = 40mm

V. CONCLUSION

An apparatus for extracting the juice of sugarcane has been conceived and built. It was observed that the optimum performance cannot be maintained over a long processing period because of the observed bluntness in the perforated grating drum over time of use and this causes a reduction in the extraction efficiency of the machine. This was due to the fact that the optimum performance cannot be maintained over a long processing period. In a compression chamber, further work needs to be done on the organisation of the new component, which will modify some of the processing elements that are affecting the production of pricey juice from cane fibre. The developing machine is easy to use and maintain, as well as being inexpensive thanks to its minimal operating and maintenance expenses, all while maintaining a high level of dependable efficiency. In the event that it is put into production and sold to the public, the device has the potential to make significant strides toward resolving the issue of domestic sugar-cane juice extraction for the purpose of meeting local demand, thereby contributing to the fulfilment of the nation's sugarcane requirements.

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