IARJSET

ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 8, Issue 9, September 2021

DOI: 10.17148/IARJSET.2021.8960

DESIGN AND FABRICATION OF PEPPER THRESHER MACHINE

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Abstract: Processing of pepper involves different unit operation such as threshing, drying, cleaning and packaging. These operations are important to ensure clean and quality product. The threshed and dried black pepper has irrelevant matter like spent spikes, pin heads, stones, soil particles …etc, mixed with it. Cleaning on small scale is done by winnowing and hand picking which still consist of some impurities. This manual method used for cleaning is time consuming and also work involves human labour.

Hence to overcome the above mentioned problems in this project, "Design and Fabrication of Pepper Thresher Machine", is used which results in rich grade of pepper is collected in separate chamber and dust is collected in other side of tray.

This project aims at reducing human labour and time involved in the traditional way of cleaning. Just one person is capable of carrying out the entire separation and cleaning operation. In a short duration of time the machine can convert large quantity of impure raw material into acceptable final products.

Keywords: Threshing, Drying, Cleaning, Grading

1. INTRODUCTION

Pepper is a flowering vine in the family Piperaceae, cultivated for its fruit which is usually dried and used as a spice and seasoning, known as a peppercorn, it is approximately 5 millimetres (0.20 inches) in diameter and dark red, and contains a single seed like all drupes. Peppercorns and the ground pepper derived from them may be described simply as pepper, or more precisely as black pepper (cooked and dried unripe fruit), green pepper (dried unripe fruit), and white pepper (ripe fruit seeds). Black pepper is native to south India and is extensively cultivated there and elsewhere in tropical region.

Figure 1.1: Pepper

Figure 1.2: Separation of pepper spikes

Figure 1.3: Cleaning of pepper

As show in the figure 1.1, the word "pepper" has roots in the Sanskrit word pippali for long pepper. A single stem bears 20 to 30 fruiting spikes. The harvest begins as soon as one or two fruits at the base of the spikes begin to turn red, and before the fruit is fully mature, and still hard. The spikes are collected and spread out to dry in the sun, and then the peppercorns are stripped off the spikes.

As shown in the figure 1.2, the pepper is separated from its spikes by spreading the pepper spikes on a large level surface and stamping them manually with bare feet, until the pepper separates from the spikes. It has got many disadvantages like more damage to the pepper, less efficient. The threshed and dried black pepper has extraneous matter like spent spikes, pin heads, stones, soil particles …etc, mixed with it.

As shown in the figure 1.3, cleaning is done by winnowing and hand picking which removes some of the impurities. It is very much time consuming process and it requires more human effort.

Due to this manual process in industries and rural areas there is wastage of money and time. In order to avoid this wastage, we have designed the following model called Pepper Thresher Machine. This is an advanced and easy process to separate pepper from the plant. We have two mechanism one through the pedal mechanism which can run without current supply and another through the motor with the help of pulley and belt drive.

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2. LITERATURE REVIEW

A literature review is a written document that provides background information on the subject area and details previous research that is relevant. A literature survey is conducted to ensure to have a thorough understanding of the topic, to identify potential areas for research and also to identify similar work done within the area.

Salunkhe Prashant [1] has developed and tested Multilevel Vibration Screening Machine, this machine separate the grits of different types as well as size in less time and at cheaper cost. Machine uses a single vibrator is for all sizes of powders produced; which saves the machine cost considerably. The level of vibrations is changed in the machine which enables to vibrate the grits placed at different level one by one or at the same time. The amplitude of vibration or the frequency i.e. the number of stroke of vibration per minute can be varied which helps to apply desired vibration to the given grit; this improves the quality of powder produced as well as the rate of production. Machine is compact hence occupies less space as compared to the conventional machines.

Nagesh C Kamath [2] designed and fabricated pepper thresher. A motor provided in the model is used to actuate the whole model. Pulley is attached to the rear side of the rotating drum. This pulley is connected with the drive by means of belt as shown in the diagram. The motor is rotated with the help of belt arrangement. The drum is rotated with the constant speed of 75 rpm. Bottom having tray is used to collect the pepper. This tray is oscillated with the help of cam mechanism. This cam mechanism also operates with the help of same A.C motor.

3. METHODOLOGY

The pepper threshing machine is used to perform multiple operations. The pepper that is introduced into the hopper will fall onto the forks of machine. The rotation of forks separates the berries, forks rotate at a uniform speed. The berries then fall into the grading part and graded according to its size. Berries of different sizes are fallen into different tray. Then berries will be collected by attaching bag to the tray.

4. DESIGN AND FABRICATIONS

4.1 COMPONENTS OF MACHINE

Motor

Motor is a device that converts electricity into a mechanical motion. A three phase 1HP motor having 1440rpm is used in the “Pepper thresher Machine”.

Pulley

Two pulleys are been used out of which one is smaller other is bigger one. They are been used for the transmission of the power from the motor to the required shaft as described in the working. The two pulleys carry the rubber belt.

V-belt

V-belt is the one of the main components in the “Pepper Thresher Machine”. A V-belt is a loop of flexible material used to link between two or more rotating shafts mechanically, Belts may be used as a source of motion to transmit the power efficiency, or track relative movements.

Shaft

Shaft is a rotating machine element, usually circular in cross section. A shaft is used to transmit power from one part to another. The various members such as pulleys and gears are mounted on it.

Grade sheet

Grade sheet is the important part in the “Pepper Separation and Cleaning Machine” through which pepper is separated and cleaned from dust.

Frame

The frame structure is the combination of beams, column, and slab. The use of frame is to resist the moments which developed during the applied loading.

4.2 DESIGN OF MACHINE

Hopper is designed and it is provided at the top of the drum for the smooth flow of black pepper. The thresher is used

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for threshing the pepper. The thresher contains forks on the shaft inside the drum. The forks have projections of cone with flat top separated at uniform distance apart.

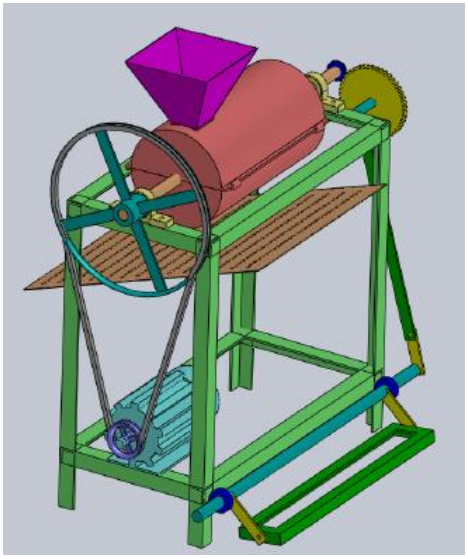

Figure 2: 3D View of machine

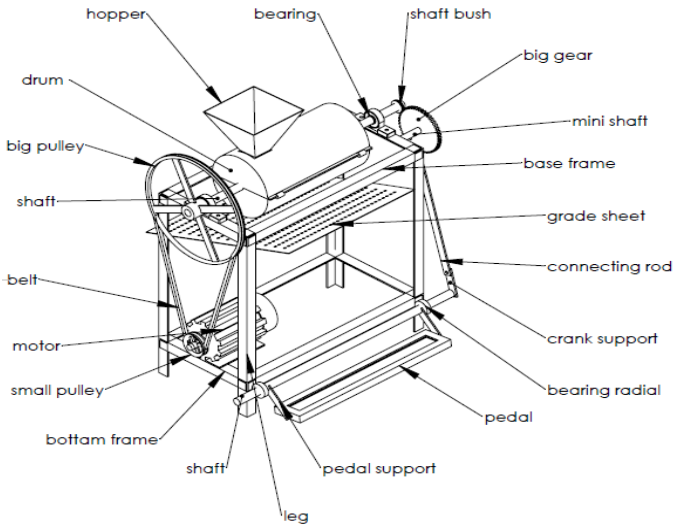

Figure 3: Isometric view of machine

4.3 CALCULATIONS

DESIGN OF BOLT

The bolts are used for fixing the connections which can be used as temporary joints. Bolts are been used as they can be removed and properly adjusted as per the requirements.

Bolt is to be fastened tightly also it will take load due to rotation.

Stress for C-25 steel f_t =120 N /mm$^{2.}$ std nominal diameter of bolt is 8 mm.

Let us check the strength:

Also initial tension in the bolt when belt is fully tightened

P = 1420 d N

P = 1420 x 8 N

P = 11360 N

Therefore the total load on bolts

F.O.S (Additional load) = 500 N

P = 11360 + 500 N

P = 11860 N

Being the four bolts the load is shared as

P = 11860/4

P = 2965 N.

Also,

$2965 = (\Pi /4\ dxc^{2)} \times f_t$

$2965 = (\Pi /4)\ (8x\ (0.84)^{2)}) \times f_t$

$f_t = 83.59$ N / mm^2

The induced f_t 83.59 N / mm^2 is less than the maximum ft 120 N /mm^2 hence our design is safe.

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TO CALCULATE TORQUE

The device is incorporated with 1 HP motor, then

1HP = 0.735KW

= 0.735 $X10^3$ w

= 735 w

The belt is mounted on the motor shaft on one end and pulley on the other end.
Motor shaft has v groove on which the belt is mounted. The size of the motor shaft as per the specifications
Using Hindustan motors catalogue for 1 HP motor, N =1440rpm

$P = 2\Pi NT / 60$

$0.735X10^3 = (2\Pi \times 1440 \times T) / 60$

$T = (0.735 \times 10^3 \times 60) / (2\Pi \times 1440)$

T = 4.874 N-m

$T = 4.874 X10^3$ N-mm

T = 4874 .120132 N-mm

TO CALCULATE THE BELT LENGTH

The belt is inserted on a V groove on the motor running at 1440 rpm.

The motor shaft diameter is 16 mm

d =16mm.

N_1 =1440 rpm

Motor pulley diameter d_1 = 50 mm

Where as the pulley diameter on the other side

d_2 =175 mm

The Belt having dimensions

Centre Distance = 220mm

N_2 = Speed of the pulley

d_1 =50 mm d_2 =175 mm

N_1= 1440 rpm N_2 =?

Using velocity ratio

$d_1 / d_2 = N2 / N_1$

$(50 / 175) = (N2 / 1440)$

$N_2 = (50 \times 1440) / 175$

= 411.42485 rpm.

To calculate the length of the belt, this is considered as open belt drive

$L = 2X + 1.57(d_2+d_1) + (d_2-d_1)^2 / 4x$

X=centre distance = 220mm

d_2 =175

d_1 = 50mm

$L = 2 \times 220+1.57(175+50) + (175-50)^2/ (4x 220)$

= 440+353.25+17.75568

L = 811.00568mm

= 0.8m

The length of the belt is approximately taken as 1 m

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4.4 FABRICATION

FABRICATED MACHINE

Figure 4: Pepper Thresher Machine

WORKING PRINCIPLE

The set up consisted of a horizontal rotating shaft with forks on its periphery and powered by an electric motor. It was surrounded by a stationery drum outside with two holes on it one inlet and one outlet which are opposite to each other on one end of drum and other end of drum. Pepper spikes with berries were fed into the machine through the hopper. Pepper would get threshed between rotary forks and the drum there by separating the berries from spikes. The bottom of the drum is outlet. Then it falls on the separating section which is provided with the mesh plate through which only pepper seeds would pass and the spikes would remain over it and come to other side. The vibration is provided with the help of crank mechanism and to run the machine we have two mechanism one through the pedal mechanism which can run without current supply and another through the motor with the help of pulley and belt drive.

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5. RESULTS

Manual Threshing and Cleaning by labour

Labour cost per day: **Rs. 500**

Working hours: **8hrs**

Pepper threshing and cleaning per hour: **5kg**

Total pepper threshing and cleaning for 8 hour**: 40kg (approximate)**

Pepper Threshing and Cleaning with pedal operation
Input: Pepper spikes per hour**: 15kg**

Output: Pepper berries per hour**: 12kg**

Working hours**: 8hrs**

Pepper threshing and cleaning with pedal operation with Pepper berries for 8 hours**: 96kg**

Pepper Threshing and Cleaning with motor operation
Input: Pepper spikes per hour**: 35kg**

Output: Pepper berries per hour**: 30kg**

Working hours**: 8hrs**

Pepper threshing and cleaning with motor operation with Pepper berries for 8 hours: **240kg**

Overall Result per hour:

Sl No.	Operation	Pedal operation	Motor operation
1	Input (kg)	15	35
2	Output (kg)	12	30
3	Time (hour)	1	1

6. CONCLUSION

Conclusion is drawn on the basis of the information collected on each aspect of this project. Traditionally separation and cleaning of pepper is done manually, which involves labour cost, time, physical activities, and dust. All the above problems can be completely eliminated by using the “Fabrication of Pepper Thresher Machine”. This project aims at giving separated and cleaned pepper without lowering the grade of pepper which is of paramount important, with minimum cost. This machine will be a boon for the pepper growing farmers, as pepper separation and cleaning can be done by minimum time, less or no labour, and at minimum cost.

7. FUTURE SCOPE

We feel the project that we have done has a good future scope agricultural industry sector. The main constraint of this device is the high initial cost but has low operating costs. Savings resulting from the use of this machine will make it pay for itself with in short period of time & it can be a great companion in any field.

The device affords plenty of scope for modifications, further improvements & operational efficiency, which should make it commercially available & attractive. If taken up for commercial production and marketed properly, we are sure it will be accepted in the industry. Automatic feeding of the pepper to the machine can be used to reduce human effort.

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