Design And Fabrication Of Tamarind Seed Removal Machine

R. Karthikeyan, B.E. Nirmal, M. Pravin kumar, N.K. Pavithran

Abstract: Tamarind is a seasonal crop. it's an awfully helpful kitchen product. It's once more a very important ingredient in Ayurvedic medicines. These desires are consummated by tamarind pulp, which become obtainable once the separation of seed and cover from tamarind. The standard methodology of preparation of this pulp maybe a hand method that becomes a tedious and prolonged task to remove out the cover and seed from Tamarind. Additionally, this operation desires immense manpower needs. Preparation of tamarind pulp is one in every of the joint unit enterprises in most of the villages. Tamarind seeds are separated manually which is less hygienical and grueling. All this method needs a ton of your time and hands which might be reduced by automation of the method. Continuous type tamarind deseeding machine with the deseeding capability of 9 kg/hr. has been fabricated. The machine consists of a seed separating the unit during which the fruits are subjected to shear force. Deshelled and dried tamarind is feed into tapered grooved disc one by one manually with facilitate of roller. The tapered grooved disc is driven by a motor at very low revolutions per minute. Once tamarind comes close to the cutter blade that is driven by a motor at high speed it shears the tamarind pulp. The projection in tray removes the tamarind seeds out of the oblong sieve, therefore the tamarind is deseeded. Since the machine is economical and efficient in separating tamarind seeds thus most of the farmers can afford it. The machine will scale back human labor, labor cost, and time, keeping the property of tamarind pulp of the pulp more or less unchanged

Index Terms: DC motor, Grooved roller disc, Blade cutter, Deseeded, Helical gears, Shaft, Plummer block

1. INTRODUCTION

The food industry is growing because of the demand, the consumption is at higher rate. The need of processing the food items has also to be quick and effective. Tamarind which is one of the major integrant in the food and used as everyday kitchen product. Apart from this use they also serve as ayurvedic medicine. Tamarind comprise of fruits with seeds enclosed in an encapsulated pod or cover. Since it is a seasonal crop it has to be processed to preserve it for the remaining period of the year. Tamarind fruits will be ripened in early summer. They may be harvested after 6 months after maturity so that the moisture content level is reduced but usually, they are harvested as soon as they mature and processed. Tamarind pulp is the useful thing which is used as kitchen product. In order to obtain the pulp, it has to be processed it involves removal of pods and seed from the pulp. The pods is brittle in nature and can be easily removed by impacting it usually performed manually by beating the tamarind pods it breaks and also there are few machines available to remove the pods. After this they are sun dried to reduce the moisture content to the desired level. And then feed into tamarind seed remover which was fabricated for easy removal of seed.

- *Mr.R Karthikeyan is an Assistant professor of Mechanical Engineering in*
- *Kongu Engineering College, Erode, Tamilnadu, India,.PH-7708014591.*
- *E-mail: karthi.mech@kongu.ac.in*
- *B E Nirmal is currently pursuing under graduate degree*
- *program in Mechanical engineering in Kongu Engineering College, Erode,*
- *Tamilnadu, India. PH-9553867738. E-mail: bangaruniraml1998@gmail.com*
- *M Pravin kumar is currently pursuing under graduate degree program in*
- *Mechanical engineering in Kongu Engineering College, Erode, Tamilnadu,*
- *India. PH-.8608058470 E-mail: mpkpk2@@gmail.com*
- *N K Pavithran is currently pursuing under graduate degree program in*
- *Mechanical engineering in Kongu Engineering College, Erode, Tamilnadu,*
- *India. PH-6381873487. E-mail: Pavithran.16mech@kongu. edu*

Traditional methods which are commonly used for this purpose are time consuming, less hygienic, less efficient, causes high structural damage, and require a greater number of labors. So, the major objectives is to identify a suitable mechanism for tamarind seed separation, and overcome the drawbacks of traditional method, develop a machine which is compact enough to use for household purposes as well as for small scale industries.

2 LITERATURE REVIEW

Paramasivan Karthickumar et al., (2015) deals with the machine consist of a seed separation unit and separate outlets for the seeds and deseeded fruits. In the seed separation unit, the fruits were subjected to impact and simultaneous shearing force . A.R.Lende et al., (2012) designed for removing the cover of 10 kg tamarind pods per hour and the machine giving very good result for the same. It is also possible to remove cover of more than 10 kg tamarind pods per hour. After conducting the trial, 90% cover is getting removed with two blades per disc on the shaft of TCB. Anagha Balan et al., (2017) This model consists of a handle, oscillating sector with pegs, concave sieve, frame and stand. Shell removed tamarind fruits were used for the experiment. The oscillating sector will move over the tamarind and due to the rubbing action between tamarind and pegs the seeds get removed.

3 OBJECTIVES

To develop optimum method for deseeding tamarind. Design and fabrication of tamarind deseeding machine for household as well as small scale industries

4 METHODOLOGY

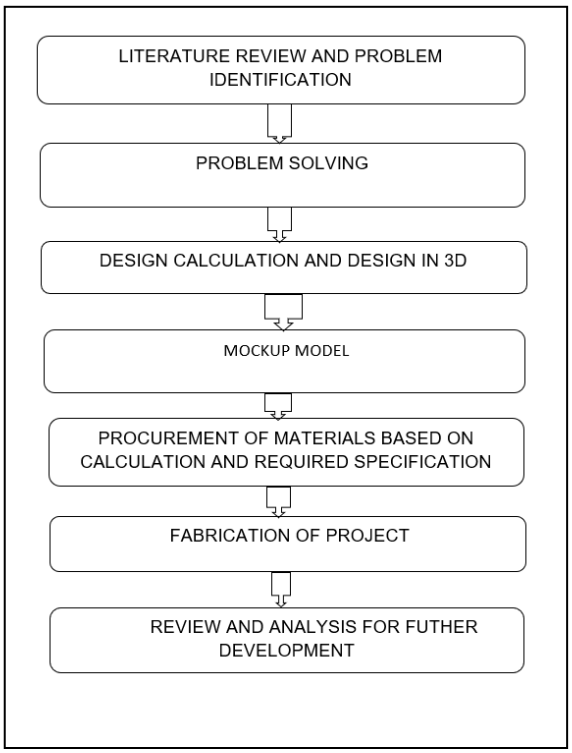


***FIG 1.1** METHODOLOGY*

5 DESIGN CALCULATION

5.1 SHAFT CALCULATIONS

Shaft is used to transmit power .it carries grooved disc in the center which nearly 5kgs. The shaft is mounted to the frame by Plummer block. Thus, frame is considered as simply supported beam and calculation is done

Calculating reactions at a and b

Ra+Rb=55N

(50*275) +(5*50) = (Rb*550)

Rb=25.45N

B

Ra=29.45N

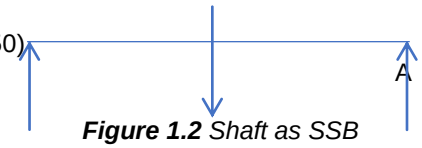


***Figure 1.2** Shaft as SSB*

From bending moment diagram

Maximum bending moment (M)=6998.5N-mm

σ= (M * r) / I ... (5.1)

σ= allowable stress

M is maximum bending moment

r is the radius

I is area moment of inertia.

For mild steel (EN3B), σ=290N/mm^2.

I=πd^4/64 … (5.2)

σ=(M * r) / I

R=10mm

So diameter of shaft is 20mm.

5.2 GEAR CALCULATION

Helical gear is used for gear reduction. The larger gear is mounted on the shaft and smaller on the motor output shaft

No. of teeth in small gear (T_1)=18

No. of teeth in large gear (T_2) =80

gear ratio(i)= T_2/ T_1=4.44 … (5.3)

speed of motor (N_1) =50rpm

speed of shaft (N_2) =12rpm

Input torque=8N-m

Output torque=35N-m

Centre distance(a) = ($d_1 + d_2$)/2=82.5 mm … (5.4)

Module=2a / (T_1+T_2) =2mm

5.3 CUTTER MOTOR CALCULATION

The dc motor use for driving the cutter is chose based on required rpm .

Dc motor 12V, 4A

RPM of cutter = 2800 rpm

Tamarind is peeled effectively at high speed, so the motor is chosen.

5.4 DESIGN OF PLUMMER BLOCK

Bearing No. 6204

Housing number = P204

Thickness (B)=14 mm

Inner Diameter (d)=20 mm

L_{10}=$(C * P)^e * 10^6$/(60*N) … (5.5)

=4.6* $* 10^{10}$cycles

C = Dynamic Capacity (N)=12863N

P = Equivalent Bearing Load (N)

N = Rotating speed in RPM

e = 3.0 for ball bearings, 10/3 for roller bearing

5.5 MOTOR SELECTION

The motor used for driving the grooved disc is chosed based on the torque and speed required to rotate it

Dc motor 12V ,4A

RPM=50

P=v*I … (5.6)

= 12*4=48W

P=2$\pi NT/60$ … (5.7)

T=8N-m

5.6 CAPACITY CALCULATION

RPM of the grooved disc = 12

(designed according to feed rate)

Circumference of grooved disc = 2 *3.14*r … (5.8)

= 1884.5mm

Where r=radius of the disc

If feed rate is 20 tamarind per minute,

The average weight of tamarind is 8grams

For a minute it can deseed 160grams .so for an hour it deseed about 9.6kg. Since it is manual feeding assume the deseeding capacity as 9kg/hr. By the manual processing the deseeding capacity is only 3 kilogram per hour

5.7 Percentage of Seed Removal

It varies from machine to machine but mainly it is depending on the following parameters,

Variety, Drying method, Rotations per minute, Percentage of matured nuts, Moisture content

Deseeding efficiency was calculated as

DSE=(S1-S2)/S1*100 … (5.9)

Where

S1= number of seeds present in tamarind before deseeding

S2= number of seeds removed from tamarind after cutting

The deseeding efficiency was found to be 90%

6 VIRTUAL MODEL

Modeling was done in CATIA V5R20. The individual parts were designed in CATIA part modeling with the required dimension obtained from design calculation and assembled. Rendering was done to different each part with specific color. Figure 6.1 shows the exact fabricated model and components used in isometric view,

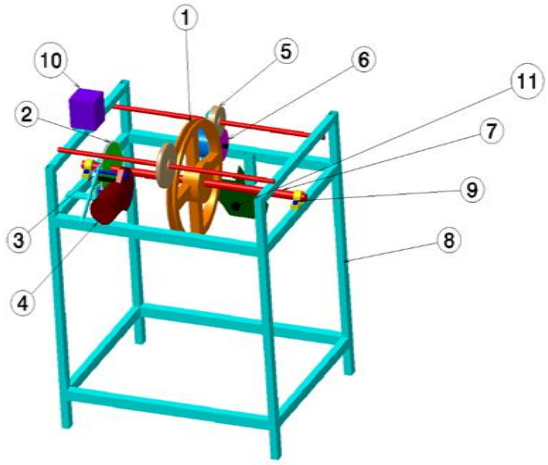
ALL DIMENSIONS ARE IN MM

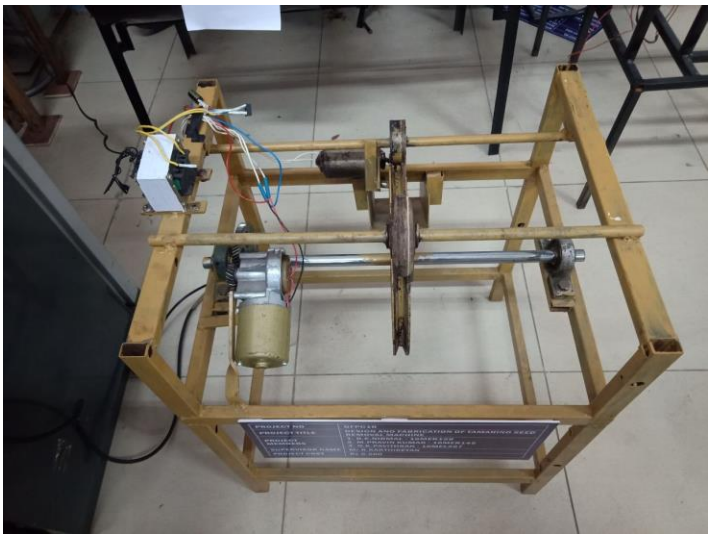
11	OUTPUT TRAY	MS	1
10	TRANSFORMER	-	1
9	PLUMBER BLOCK	MS	2
8	FRAME	MS	1
7	SHAFT	MS	3
6	MOTOR WITH BLADE CUTTER	MS	1
5	FREE ROLLERS	RUBBER	2
4	DC 12 V MOTOR AND FITTINGS	MS	1
3	PINION GEAR	MS	1
2	GEAR	MS	1
1	GROOVED DISC	MS	1
S.NO	PART NAME	MATERIALS	QTY

FIG 1.3 *ISOMETRIC VIEW*

7 EXPERIMENTAL SETUP

The setup consists of a grooved roller disc, 12v dc motor, dc motor with blade cutter, plumber block, gears, transformer, supportive rollers and frame. Dried tamarind after deshelling is feed into grooved roller disc one by one manually with help of roller. The grooved disc is driven by 12v DC motor at very low rpm. The tamarind placed in grooved disc rotates and when tamarind come near the cutter blade which is driven by another DC motor at high speed shears the tamarind pulp.In order to prevent tamarind coming up a another free rotating roller is provided The projection in tray removes the tamarind seed thus the tamarind is deseeded.





The tamarind is sundried to required moisture content level. The moisture content of different samples of tamarind that are taken for experiment are 4%, 6.5%, 8%, 10%. Number of seeds in the sample (s1) was counted before feeding into the machine. After feeding number of seeds separated from pulp is counted (s2). Samples with known moisture content were fed to the machine. Percentage of seed removal was calculated by using the formula $(s1-s2)/s1*100$. And the result were plotted in a CHART 1.1

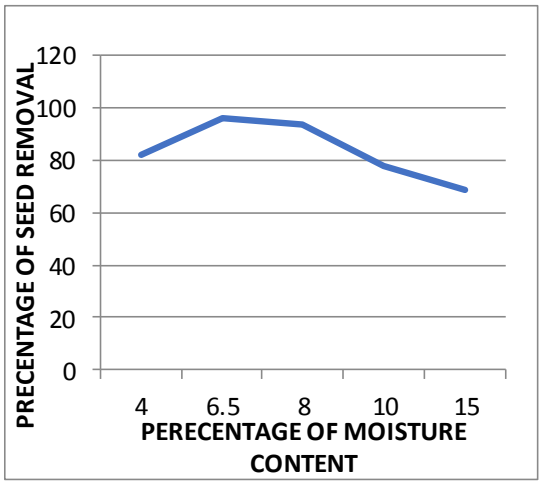


CHART 1.1 *EFFECT OF MOISTURE CONTENT*

CHART 1.1 indicates that most of the seeds were removed at moisture content level of 6.5 to 8 on dry basis. The results indicate that the machine has an average efficiency of 80% and has a capacity of 9kg per hour. It is more efficient than the traditional method. Labour and time required was very less

The RPM of the cutter was varied and in the same way the percentage of seed removal was calculated. And the result were plotted in a CHART 1.2

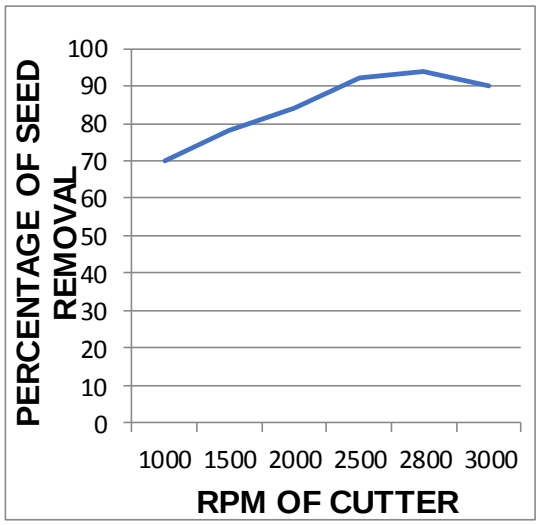


CHART 1.2 *EFFECT OF RPM OF CUTTER*

8 CONCLUSION

The capacity of the developed tamarind deseeder was 9kg per hour and the cost of operation of tamarind seed remover was Rs75 for processing 9kg, whereas the conventional manual deseeding process, the cost was found to be Rs100 for processing 9kg of the tamarind fruit. The conventional method of deseeding is more expensive than mechanical deseeding. Mechanical deseeding saves operation cost and operation time. The deseeder has a compact design and a robust outlook. It will contribute to the enhancement of tamarind processing as it could be used to eliminate the tediousness of the present traditional methods of tamarind deseeding. This machine reduces human effort as well as the time involved in the manual operation of people so that improving their working method. The results of the trials are satisfactory for the seed removal process. Thus it can be used for households and small scale industries.

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