Tomato Seed Removing Machine(Design Calculation And Testing)

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Abstract- *This paper presents the design model and consideration of various factors for tomato seed removing machine to obtain seeds with related research and proper calculations .The study shows the factors influencing the tomato seed removing process and gives us the estimate amount of force,power and at what amount and at what rate the material will be required. These are based on systematic study and calculation of tomato seed removing process and testing of a new model of seed removing machine.The traditional methods are not sufficient & satisfactory for removing the seeds from tomatoes and therefore this machine might be the solution to that problem.*

Keywords- Models, Design, seed, Calculations, Agriculture, Belt, Shaft, Pulleys, Diameter

I. INTRODUCTION

The Basic occupation of about 90% of population in India is agriculture. A variety of vegetables are produced in India. But most of the agriculture sector is in the need of quality seed for plantation and this gives rise to the need of quality seed. The extraction of seed from tomato is very difficult and to preserve that seed is even more difficult.

The quality of seed should not be affected by extraction method , fermentation temperature and duration. The gelatinous coating of from the seeds need to be removed .For this various process or steps are taken like removal of gel coating by fermentation, by hand or in this case by machine .In fermentation methods, the selected ripe fruits are harvested, crushed and allowed for fermentation in non-metallic containers at room temperature for two to three days. Each technique have its advantages and disadvantages which depends upon temperature, application and period. In fermentation process, the good seeds settle down at the bottom and much of the pulp floats at the top, leaving a layer of clear liquid in between. For fermentation to take place sufficient disintegration mucilaginous material adhering to the seed. Temperature plays a key role in fermentation to take place. Tomatoes are required worldwide because of its many uses and is easily available in most of the countries, therefore good quality of seed for vast production of tomatoes are must. Handling ,storage and processing of tomatoes is also should be taken into account .The pulp obtain from the process is seed free and can be used to make sauce, tomato juice, pickle etc and many other uses. Many sauce making industries remove the seed from tomatoes to get the perfect taste from the tomatoes

II. CAD REPRESENTATION AND CONCEPT

The step The fig Below Represent The proposed Cad Design according to which the design calculations and testing was done .The Hopper is the Input i.e through which the raw tomatoes are fed to the machine .The fig 2 shows How the cutter hopper assemblies product is fed to the seed separating part of the machine .In the front view representation fig 1 as we can see that a double grove pulley is used .This double grove pulley is attached to the sieve shaft so that motor input could be obtained by speed reduction.The double grove pulley transfer the torque to cutter pulley without any speed reduction .When the tomatoes are fed in the hopper the spiral arrangement of blades cut them to pieces.These sliced tomatoes are then put in a rotary sieved drum ,which separate the seeds .Thus the following cad representation is to show the working concept of our proposed model of tomato seed removing machine

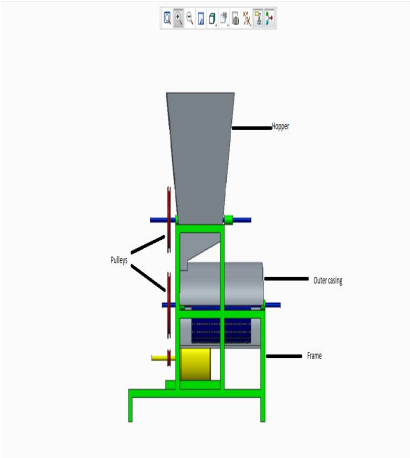
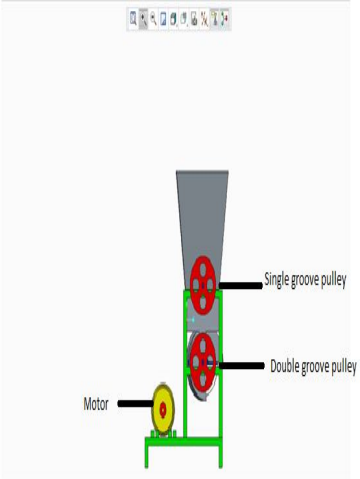


Fig.1



FRONT VIEW

Fig.1

III. DESIGN PARAMETERS

After completing the design of semi-atomize machine, development is done on cutting machine. Parameters are selected according to objectives, 3D diagrams & photos of each components assembled machine and line diagrams with labeling are mentioned.. The various instruments used for fabrication of machine are also mentioned. Following are the main components of machine:-

1) Hopper
2) Sieve or circular net
3) Circular Shaft
4) Cutting Blades
5) Bearings
6) Pulleys
7) Foundation Frame

Design And Calculations

For removal of seed

Suction pressure was calculated about 10cm of H20(980.62pa) {TOMATTO DECORING MACHINE REVIEW}
Therefore, by taking slice radius as 8cm we can calculate for required force

F=P*AREA
=980.62*(3.14/4)*(0.08)^2
=4.82N

Now considering 300rpm, and mass of slice as 20gm centrifugal force will be

F=m*r*W^2=10.2N

Hence, design is feasible.

Design of v-belt

Design power= Pr*Kl ----(T-XV-9)
=746*1.10
=820.6 Watts

Where Pr = rated power
& Kl= load factor=1.10 ----(T-XV-2)

Now,

For range of Pd=0.3-3.5 Kw
Pd=0.820 Kw
Designation of belt "A"
Thickness =t=8mm
Width =w=13mm
Centrifugal tension=Kc=2.52
Small pulley diam.=D1=75mm
No .of strands =6
N1/N2=D2/D1
1000/300=D2/75
D2=250m
C=D2+(D1+D2)/2
C=287.5mm

Power per belt:

$$P/B = (Fw-Fc)x \frac{e^{\frac{\mu\theta}{\sin(\frac{\alpha}{2})}}-1}{e^{\frac{\mu\theta}{\sin(\frac{\alpha}{2})}}} *Vp$$

where, Fw=w^2=working load
=169N
Fc= centrifugal tension
$=Kcx(\frac{Vp}{5})^2$
Where, $Vp=\frac{\pi D1N1}{60x1000}$
Vp=3.92m/sec
Vp=235.61 m/min
θmax=3.75
θmin=2.53

Power /belt =592.65 W

No.of belts = Design power/power per belt
= 820.6/592.65
= 1.38=2

Groove section

Width of pulley = (n-1)xe+2f

= (2-1)x15+2x10.5
= 36mm

Length of belt $=\frac{\pi}{2}X($D1+D2)+2C+$\frac{(D2-D1)^2}{4C}$

= 1112.13
Material of pulley is CI
No.of arm=4
No of sets =1

Shaft design

Td=$\frac{PdX60}{2\pi N1} = 7.83Nm$

Material – En8
= 510 Mpa
= 245 Mpa
τmax=0.18sut =0.18X510 =91.8 Mpa
τmax=0.30syt=0.30X245=73.5Mpa
As key slot provided
τmax=73.5X0.75 =55.125 Mpa

7.83=$\frac{\pi}{16}$Xd^3X5 5.125

D = 8.97mm
As diam. Is smaller as compared with pulley ,so increase diam by 50%
ds= 8.97X1.5=14
Hub diameter=1.5xds+25=46mm

Belt tension ratio

F1/F2=$\frac{u\theta}{e^{\sin(\frac{\pi}{2})}}$

F1=10.29XF2
F1-F2=Pd/vp =209.183---- (1)
put F1 in (1)
F2=22.51N-----slack side
F1=231.62N----Tight side

Moment M=$\frac{(F1-F2)X(D2-Dh)}{n}$

=$\frac{(231.62-22.51)X(250-46)}{4}$

M= 10664.61 N-mm

Face width = 1.1Xb =1.1X3.3
=3.63mm

Rim thickness =0.375X$\sqrt{D1}+3$---for small pulley
=6.25mm
=0.375$\sqrt{D1}+3$----for large pulley
=8.93 mm

IV. TESTING DATA CONCLUSION

Maximum Capacity of machine =5kg
Rate of Cutting =2.5 kg/min
Seed Removal Rate=25gm/min
Actual speed of motor=1340 rpm
Speed of cutter shaft=346 rpm
Speed of rotating drum =363 rpm
Total weight of machine=56 kg
Efficiency of machine=90%
The seed rmoved in grams to the input tomatoes in kg is given in the graph below in fig 3

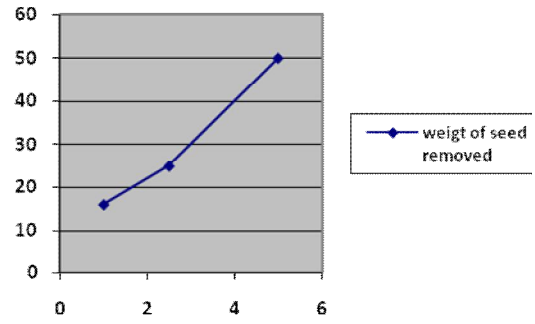


Fig.3

V. CONCLUSION

On the basis of design parameter followed by the calculation performed keeping in mind those parameter we have designed the measurements of all the materials we will be needing. The design model can be easily understood in the above figures provided with various parts. This will provide the guidelines for the manufacturing of machine and give us the detail aspect of various parameters.The testing data obtained also provide satisfactory conclusions

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