

Design and Development of Peanut Peeling Machine

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Abstract- This work is related to design and development of electrically operated roasted peanut peeling machine and testing and analysis of peanut which includes size variation, compressive strength, roasting temperature and time of roasted peanuts. There are basically two types of peanuts which are widely used for domestic and industrial applications of food products they are Java type and bold type. Bold types of peanuts are used in our work as they are mostly used in confectionary and food industries also out of total peanut consumption 60% to 70% are of bold type as well as its compression strength is greater than other peanuts, reason for this is, it is long in length and sweet in test than other. From our observations it is found that the length of peanuts varies in the range of 14mm to 18.4mm and diameter of peanuts varies in the range of 9mm to 10.6mm. The average compression strength of bold type peanuts with roasting is 308 gram/cm². For effective peeling, peanut should be sand roasted and sand temperature is kept in the range of 150°C to 160°C for 45 seconds to 60 seconds. In testing an average of 5.042 kg of roasted peanuts was fed into the machine; this produces an average mass of 3.989 kg of peeled roasted peanuts, 0.605 kg of unpeeled peanuts and 0.448 kg of broken peanuts. An average time of 248 seconds and efficiency of 79.129% was recorded. The machine is easy to operate and has a peeling capacity of 75kg/hrs. With this capacity this machine can be useful in confectionary and food industries for need of peeled roasted peanuts.

Keywords-- Roasted Peanuts, Peeling Machine, Design and Development, Size Variation, Compressive Strength, Peeling Rate.

I.INTRODUCTION

Agriculture is the backbone of India. The peanuts also known as groundnut is one of the major crop in the world, it is grown in rain-fed regions in India. Gujarat, Andhra Pradesh and Tamilnadu states are in front for producing peanut crop.

Gujarat state share more than 50% production of peanut crop [1]. The peanuts contain 48% to 50% oil, 26% to 28% protein and 11% to 27% carbohydrates and it is an important diet to man [2]. There are various food industries that use the roasted peeled peanuts for making food items. With such a condition the problem in country like India in peanut production is the insufficiency of peanut processing machines which will peel the peanuts with minimum damage and efficient peeling rate. The machines which are currently available for processing peanuts are manually operated, either by hand or pedal and the output from such machines are not remarkable also not satisfying market demand. Lots of works have been carried out on the design of machineries which processes the peanuts. Recent works on roasted peanuts peeling machines both manually and electrically operated are included in work ([3]-[6]). The aim of this work is to make a machine, whose production capacity is more along with peeling efficiency.

II.TESTING AND ANALYSIS OF PEANUTS

Commonly used peanuts in market There are number of peanut types available in market coming from different areas of world and India. Out of that there are two main types which are widely used for domestic as well as industrial applications and products. That are-

- 1.Round Type called as Java Type peanuts
- 2.Long Type called as Bold Type peanuts



Fig.1 Java Type peanuts



Fig.2 Bold Type peanuts

A.Size Variation-

Here the diameter and length of both java type and bold type peanut is measured by the vernier calliper and the average values of diameter and height are calculated and tabulated in table. They are given in following table.

TABLE I
Size variation of peanuts

Sr no.	Java type (Sample-1)		Bold type (Sample-2)	
	Diameter (d) in mm	Height (L) in mm	Diameter (d) in mm	Height (L) in mm
1	9.02	15	10	18.2
2	10	14.18	8.6	15
3	8.56	15.1	8	17
4	8.64	13.62	10.6	18.4
5	9.16	12.5	9	15
6	9.4	16.68	8.2	16
7	10.4	12.7	10	16
8	9.3	14.4	8.5	16
9	9	11.38	9.6	15.02
10	7.6	12.1	9	15.5
11	9.1	14.5	8.6	15.3
12	8.8	14.5	8.4	14
13	7.9	12.5	8.7	15.6
14	9.7	14.9	8.8	16.28
15	9.38	12.55	9.2	14.7
Mean =	9.07	13.77	9.2	15.86

Observations-

1.The diameter of peanuts for Sample 1 is ranges from

minimum 7.6 mm to maximum 10.4 mm and diameter of peanuts for sample 2 is ranges from minimum 8 mm to maximum 10.6 mm.

2.The diameter of peanuts for sample 1 is lower than the diameter of peanuts for sample 2.

3.The height of peanuts in sample 1 is generally ranges from minimum 12.1 mm to maximum 16.68 mm and for sample 2 is ranges from minimum 14 mm to maximum 18.4 mm.

4.The height of peanuts for sample 1 is lower than for sample 2.

B.Compressive Strength of Peanuts-

The compressive strength of both type of peanuts are calculated by using compression strength measuring machine. The compression strength of peanuts without roasting and with roasting is given in the table II and table III respectively.

TABLE II
Compressive Strength: - (Without roasting)

Test no.	Sample-1	Sample-2
	Compressive Strength (gram/cm ²)	Compressive Strength (gram/cm ²)
1	380	100
2	210	350
3	160	290
4	210	140
5	320	220
	Average=256	Average=220

Observations:-

1.The compression strength of sample 1 is greater than the sample 2 before roasting.

2.The mean value of compressive strength is 256 gram/cm² and 220 gram/cm² for sample 1 and sample 2 respectively.

TABLE III
Compressive Strength: - (With roasting)

Test no.	Sample-1	Sample-2
	Compressive Strength (gram/cm ²)	Compressive Strength (gram/cm ²)
1	300	180
2	300	280
3	200	350
4	250	400

5	260	330
	Average =262	Average =308

Observations:-

- 1.The compression strength of both sample 1 and sample 2 increases after roasting due to increase in hardness.
- 2.The compressive strength of sample 2 is greater than sample 1.
- 3.The mean value of compressive strength is 262 gram/cm² and 308 gram/cm² for sample 1 and sample 2 respectively.



Fig.3 Compressive strength testing machine

C.Calculations of number of peanuts in 1kg peanuts

Volume of peanut is given by,

$$\text{Volume (V p)} = \pi/4 \times d^2 \times L$$

$$[\text{Sample 1} = \pi/4 \times 9.022 \times 13.77 = 879.9 \text{mm}^3 = 8.79 \times 10^{-7} \text{ m}^3]$$

$$[\text{Sample 2} = \pi/4 \times 9.22 \times 15.86 = 1054 \text{mm}^3 = 1.0543 \times 10^{-6} \text{ m}^3]$$

Density of peanut (ρ p) = 721 kg/m³

So, For Sample no. 1,

$$\text{Mass} = 1 \text{ kg.}$$

Hence, the volume for 1kg peanut, Volume for 1kg peanuts =

$$\text{Mass/Density} = 1/721 = 1.386 \times 10^{-3} \text{ m}^3$$

$$\begin{aligned} \text{Hence number of peanuts in 1 kg.} &= \text{Volume of 1 kg.} / \\ \text{Volume of one peanut} &= 1.386 \times 10^{-3} / 8.79 \times 10^{-7} \\ &= 1576. \end{aligned}$$

Now, For Sample no. 2, Mass = 1 kg.

$$\begin{aligned} \text{Hence number of peanuts in 1 kg.} &= \text{Volume of 1 kg.} / \\ \text{Volume of one peanut} &= 1.386 \times 10^{-3} / 1.0543 \times 10^{-6} \\ &= 1314. \end{aligned}$$

No of peanuts/kg,

$$\text{Sample-1} = 1576$$

$$\text{Sample-2} = 1314$$

D.Selection of peanut type for machine.

We selected the bold type of peanuts for further works. It is mostly used in confectionary and food industries. Out of total peanut consumption about 60% to 70% are of bold type peanuts. Reason For this is, it is long in length and having better sweet test than other type of peanuts.

E.Temperature range and time for roasting of peanut

In this section the measurement of roasting temperature of peanuts in furnace is done by using thermocouple and time for roasting is measured simply by stopwatch. To get good quality of roasting, the peanuts were roasted in the temperature range of 150°C to 160°C for 45 seconds to 60 seconds. Roasting should be done in sand i.e. sand roasting or with the help of equivalent roasting equipment.

III.DESIGN CALCULATIONS

Shaft Design

We used a motor having power of 0.75KW, which has speed of 1440 rpm.

$$\text{Power (P)} = 750 \text{ watt, Speed of motor (N)} = 1440 \text{ rpm.}$$

Hence, Torque can be given as,

$$\begin{aligned} T &= P \times 60 / 2\pi \times N \\ &= 750 \times 60 / 2\pi \times 1440 \end{aligned}$$

$$T = 4.973 \text{ N-m}$$

Maximum bending moment (M) = 11.54 N-m

Equivalent Twisting moment T e = 12.56 N-m

Selecting shaft material SAE 1030

Yield strength = 440 Mpa

Diameter of shaft calculated = 8.22 mm for safety considerations rounded of to 20 mm.

IV.WORKING PRINCIPLE

The peanut peeling machine works on the principle of

shearing action. The machine comprises a compartment in which a food grade rubber is pasted. Roller contains a through shaft which is mounted in bearings. Initially the peanuts are fed to machine with specially designed hopper, hopper consist of a peanut flow controlling mechanism. Then peanuts come in contacts with the rubber roller and fixed side plates of machine, as the rotary motion is given to the roller's shaft by means of a motor peanuts gets peeled by combined action of rotation and shearing. Resulting in white polished peanuts. The slop is given to the compartment hence gravity assists the peanuts to come out from one side of compartment and collected in bottom pan. The brownish layer chaff is collected at bottom of compartment.

V.FINAL MODEL OF PEANUT PEELING MACHINE

Fig.4 shows actual model of peanut peeling machine.



Fig.4 Final Model

VI.TEST AND RESULTS

The roasted peanuts were fed through the hopper into peeling compartment. Once the roasted peanuts entered in compartment the peeling of roasted peanuts are taken place. The time required to peel the roasted peanuts are recorded by using stopwatch. The roasted peanuts varies in the range of 4.84 Kg to 5.2 Kg were fed. The weights of peeled, unpeeled and broken peanuts were measured by using electronic weighing machine. The results obtained are tabulated in table

IV.TABLE IV

Results obtained with peanut peeling machine

Sr.no	Total mass of roasted	Mass of peeled roaste	Mass of unpeeled peanut	Mass of broken peanut	Time taken to peel the	Peeling efficiency in % $\eta_p =$
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	peanuts fed into hopper in Kg(M ₁)	peanuts in Kg (M ₂)	skins in Kg(M ₃)	skins in Kg (M ₄)	roasted peanuts in seconds (T)	$\frac{M_2}{M_1} \times 100$
1	5.2	3.92	0.78	0.5	267	75.38
2	5.1	4.29	0.52	0.29	259	84.11
3	5.0	4.34	0.44	0.22	243	86.80
4	5.0	4.13	0.81	0.06	246	82.60
5	4.9	3.83	0.59	0.48	236	78.16
6	4.84	3.68	0.46	0.7	204	76.03
7	5.10	3.57	0.75	0.78	255	70.00
8	5.15	4.17	0.63	0.35	262	80.97
9	5.0	4.09	0.34	0.57	245	81.80
10	5.13	3.87	0.73	0.53	263	75.44
11	Average = 5.042	Average = 3.989	Average = 0.605	Average = 0.448	Average = 248	Average = 79.129

After number of trials we found that the peanut peeling rate for our machine was 75 kg/hrs. = 1.25 kg/min

VII.CONCLUSIONS

This work represents to the testing and analysis of peanut size, compressive strength, roasting time and temperature along with design and development of electrically operated roasted Peanut Peeling Machine. The machine is constructed by using available parts and materials which are less costly. Hence the machine is not expensive, so it can be used for domestic as well as for industrial applications. The weight of our machine is around 18 kg so it can be transported anywhere for use. The rate of peeling of our machine is about 75 kg/hr. And the efficiency of our machine is found by testing is 79.129%. This machine will reduce manpower and time also.

ACKNOWLEDGMENT

We would like to express our gratitude to Prof.A.S.Adadande for guiding us through this research work. The support extended by Mr Mahesh I. Nirmale, electrical engineer, is highly appreciated and acknowledge with due respect.

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