Oil Expeller Machine

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Abstract— There are many varieties of seeds and nuts that can produce oils for food, nutraceuticals, skincare products, aromatherapies, fuels and industrial lubricants. This paper will describes the basics processes of oil removing machine, constructional features of oil expelling machine.
Key words: oil expeller, Crusher, heating

I. INTRODUCTION

Now a days Farmers, small scale business men's, health care centres, domestics uses requires fresh oil from seeds and nuts by extracting oil instantly. This is done with the help of oil expeller machine the machine is generally small in size it can extract oil form grapes seeds, sesame, safflowert, canola, coeonuts , peanuts, walnuts .etc. this oil are famous for health benefits and their unique flours.

Expeller has horizontal metal shaft which is In casing where it get crushed with help of worms crew and casing the oil produced in this crushing is settle at bottom and this oil is drain through holes small holes. The crushed material is collect from another side of casing this expeller screw is driven by electric motor and speed reduction gear box as the machine construction and parts are easily manufactures hence it can repairs at small workshops easily.

II. HISTORY OF TECHNOLOGY

In historical period oil is extracted from seeds and fruits mechanically with the help of vertical millstones. This millstones are moves around the central post. Later this mechanical arrangement is drive by the windmills, watermills as shown in figure this kind of oil expeller process 100 to 200 tones of raw material per year.

Fig. 1: Millstones

Fig. 2: Water mills

Fig. 3: Windmill

Mr. Valerius D. Anderson invented a revolutionary new way to obtain oil in 1888. He invented the continuous mechanical screw press that is still the working basis of all mechanical screw presses today. He produced oil from raw materials like nuts, seeds and algae. The raw materials are crushed at high pressure in single step. As the raw material is pressed, friction causes it to heat up; in the case of harder nuts (which require higher pressures) the material can reach temperatures of 50–99 °C. Such kind of expeller cannot remove every last trace of liquid from raw material. A significant amount of oil is remains in the raw material .from this kind of raw material various food dishes are made. And also used as animals food

III. CONSTRUCTION

Parts of oil expeller machine are as follow:

1) Frame
2) Screw Feeder shaft
3) Oil collector tray
4) Hopper
5) Bearing
6) Motor and gear box
7) Belt and Pulley Transmission

A. Frame

Fig. 4:

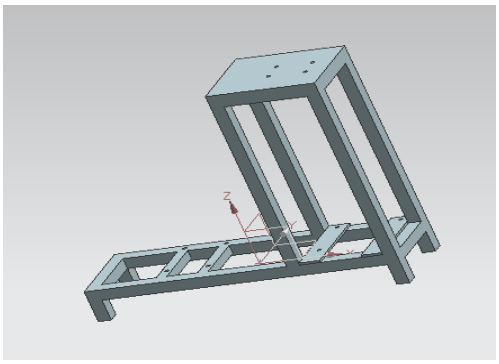

Fig. 5:

Selection of Material for Frame:-

Assumptions

(Area of frame = 600 × 400 mm^2)

Total load on frame is about 16kg(Including Weight of all component)

F = 16× 9.81

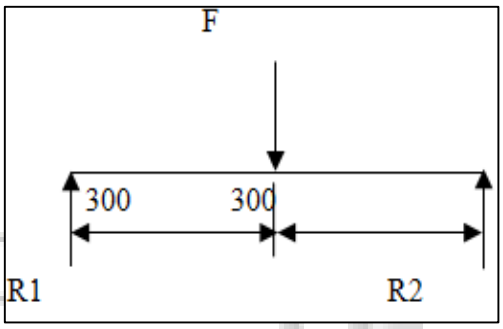

Fig. 6:

F = 156.96 N

This load is applied at the center as shown in fig

R1 +R2 = F

And

ΣM_{R1} = 0

F × 300 - R2 × 600= 0, 156.96 × 300 – R2 × 600 = 0

Therefore,

R2 = 78.48

R1 + 98.1 = 156.96

R1 = 78.48

M_b = 78.48 × 300

M_b = 23544

Y= b/2 ……..……..(b = width of pipe used)

Y = 30/2

Y = 15mm

I = bd^3 / 12

I = d^4 / 12

I = $(15)^4$ / 12

I = 4218.75

Stress on frame,

σ = M_b y / I

σ = (**23544**× 15) / 4218.75

σ = 83 N / mm^2

σ = S_{yt} / fos

therefore,

S_{yt} = σ × fos

S_{yt} = 83 × 2 …… (assuming fos = 2)

S_{yt} = 166 N / mm^2 , Selecting material **GCI 15** having Tensile strength (min) = **170 N / mm^2**

Therefore all assumptions are in safer state.

B. Screw Feeder shaft

It is subjected to bending stresses hence design against Bending Failure.

According to maximum shear stress theory design of shaft is shown below:

1) Screw Feeder length is 220mm

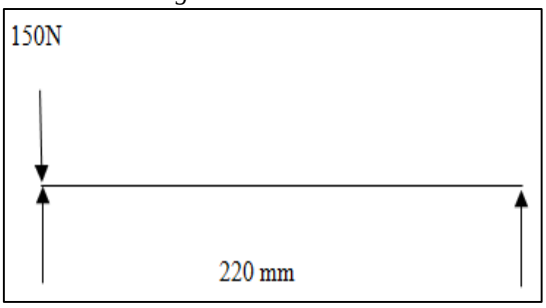

Fig. 7: Loading Diagram for Axle

150 N is the force required to crush the peanuts.

The Load **Screw Feeder shaft** 150N.

R1 +R2 = F

And

ΣM_{R1} = 0

R1 = 150

Because load of shaft is on one end only

Maximum Bending Moment will be at center.

Maximum Bending Moment = R_A * 150

M_{max}= 220*150

M_{max}= 33000Nmm

$T_e = (\ \ (K_b * M_{max})^2 + (K_t * T)^2\ \ )^{1/2}$

T_e= 1*M_{max}.....(As K_t = 1 But T = 0 , as there is no torsional moment, and $K_b = 1$ forGradual loading)

$T_e = M_{max}$ =33000Nmm

According to Maximum Shear Stress Theory [11]

$\tau = \frac{16 * T_e}{\pi * d^3}$

$d^3 = \frac{16 * T_e}{\pi * \tau}$

$\tau = \frac{0.5 * S_{yt}}{FOS}$

S_{yt}=827 of shaft material check design data book

Fos =2

$\tau = \frac{0.5 * 827}{2}$

τ = 206.75 N/mm^2

$d^3 = \frac{16 * 33000}{\pi * 206.75}$

d = 9.33mm

2) Hence we choose the shaft of 10mm

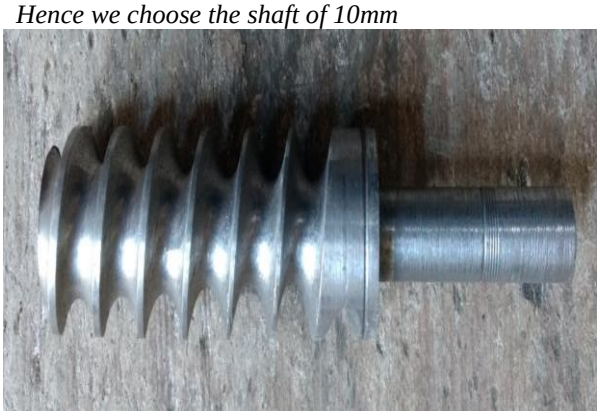

Fig. 8:

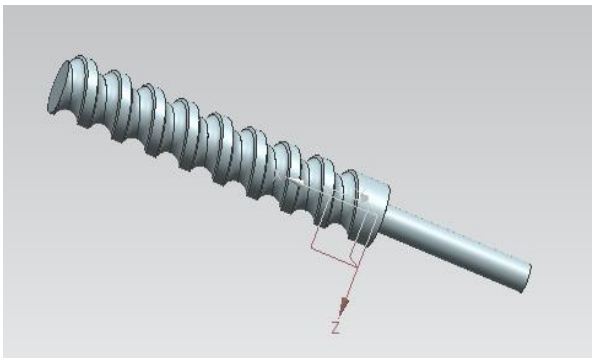

Fig. 9:

C. Oil collector tray

This is trapezoidal shape tray made of stainless steel sheet.

Fig. 10:

D. Hopper

It is also made of stainless steel sheet which is use to feed the raw material to crushing unit.

Fig. 11:

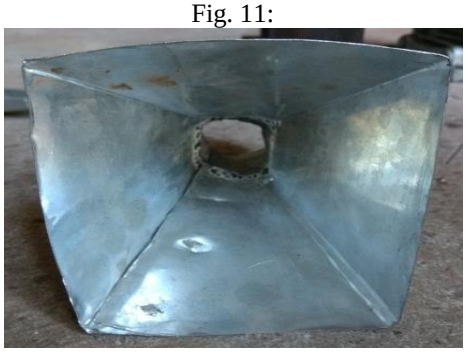

Fig. 12:

E. Bearing

It is ball types bearing with external lubrication system. Which is use to provide alignment to the crushing screw of diameter 10 mm.

Fig. 13:

F. Motor and Gear Box

We have to find out which motor is required to meet the above forces 150N

Suppose we take the motor of 1Hp =746Watt and 1440rpm standard motor

POWER= 2πnT/60

To find out the torque

746=2 x 3.14 x1440 x T/60

T=4.96=5Nm

If we consider pulley of 3inch =0.0762 for shaft

T= forces x perpendicular distances

T= 150 x 0.0762

T=11.43Nm

If we add factor of safety because we have to crush the nuts it frequently found that if we crush and press any solid material in screw feeder it stick to wall of chamber and may cause jamming of movement in such cases max FOS is 4 to 10

We take in between 6

Toque required is about 68.58Nm

POWER= 2πnT/60

746=2 x 3.14 x n x 68.58/60

N=103rpm

To decrees the rpm of motor required we have to find out the ratio

Ratio=1440/79

Ratio=13.98=14

The standard gear box is available with ratio of 15

Hence we choose the motor of 1Hp and gear box of 1:15 ratio

Fig. 14:

Fig. 15:

G. Belt and Pulley Transmission

For power transmission between motor and screw feeder shaft v- belt and Pu8lley arrangement system is use.

IV. WORKING

1) To remove from the seeds there are basically two methods
   1) Hot oil extrusion method
   2) Cold oil extrusion method
2) In this project we are going to use hot oil extrusion method. For this we are going to provide heating arrangement to crushing area. This heater will we power by A.C. supply.
3) At very first step, the raw material i.e. Peanuts seeds will feed from hopper in to the screw crushing casing at constant rate. This feeding rate will depends upon the diameter of hopper.
4) The screw crusher will driven by an electric motor and the gear box. These are power by electric supply of 240 volts A.C.
5) Screw crusher work is further divided in top the two sections.
6) In the first section i.e. at the entry of peanuts seed in to casing crushing process is carried out on peanuts seed without providing the heat to crushing
7) At the second stages of crushing, peanuts seeds is crushed as well as heat at the same time.
8) This heating will help to remove more oil from seeds. Hence we choose the hot oil extrusion method for this project.
9) The oil removes at this portion of crushing is settle at the bottom side of screw crusher casing.
10) This settle oil is drain out through the small hole which are already present at the lower side of casing.
11) This removed oil we can directly use or we can purify it.
12) The crushed seed material is get removes at the end of crusher through the holes.
13) Secondary product i.e. crushed seed material is use various food dishes, for animals food and for fertilizer also.

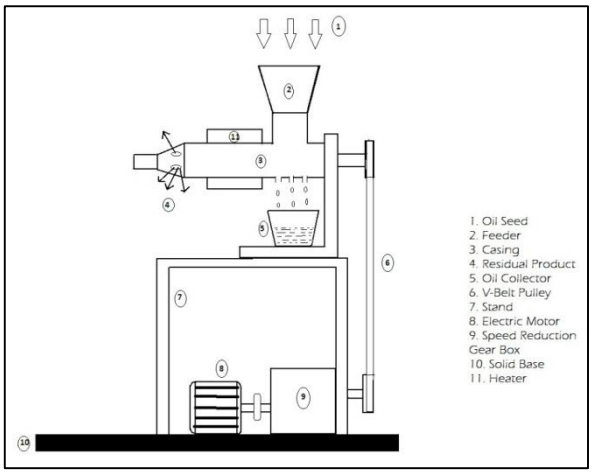

Fig. 16: Oil Expeller Machine Setup

V. ADVANTAGES

1) Designed for continuous use
2) Easier to the raw material in to hopper
3) Works quite.
4) Less expensive for small and large Uses.

VI. DISADVANTAGES

1) Difficult to adjust for different sizes of seeds
2) Needs more constant monitoring

VII. CONCLUSION

In working of domestic oil expeller machine many problems are seen like failures of parts like shaft , shaft key, worm screw thread, gear teeth failure etc. This all happens due to high crushing force demand to crush the material. But it produces the high repetitive force on parts of machine. hence they get fail easily. This failure will increase the breakdown of machine and decrease the productivity is machine. Hence to overcome this failure the efficient design of machine parts and factor of safety should be considered.

After conducting the test on the project with hot oil extrusion method for 1 kg of groundnuts we get near about 450-500 ml of oil. Same test we conducted for cold oil extrusion we get 325 ml of oil from 1 kg of groundnuts. This shows that hot oil extrusion is better than cold oil extrusion method.

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