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Development of Domestic Purpose Hydraulic Press Oil Expeller

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Abstract:- **Considering the increasing levels of booming technology in use of hydraulic and pneumatic power in transmission of force. And considering the increase in adulteration of edible oil in this modern scenario of the world. In addition to the references of various oil Extraction methods. This fabricated model named as domestic purpose hydraulic press oil expeller consists of manually operated 5-ton bottle necked jack used to press and extract the oil from the seeds thereby to increase the mechanical advantage of extracting pure oil in home itself.**

Key words:- 5ton bottle necked jack

1. INTRODUCTION

Edible oils are used as cooking or frying medium, salad oil or in food products formulation. They are important from nutritional point of view but ensuring their purity is a concern since old times. Because of their greater demand in national and international market adulteration in high price oil with low price oil is a major issue. It can affect the health of consumers adversely. Some of the harmful effects of adulterated oil are Mineral oil and argemone oil in edible oil cause heart disorders, liver problems and cause carcinogenic effects. By investigating all such types of harmful effects of consumption of adulterated oil and taking it into account as one of the major problems in order to reduce it to an extent we have developed a 5-ton hydraulic bottle jack powered hydraulic press in order to extract fresh and pure oil from seeds in home itself.

Oil expeller:-Expeller presses (also called oil pressing) are a mechanical method for extracting oil from raw materials. The raw materials are squeezed under high pressure in a single step. When used for the extraction of food oils, typical raw materials are nuts, seeds and algae, which are supplied to the press in a continuous feed. 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 exceed temperatures of 120 °F (49 °C).

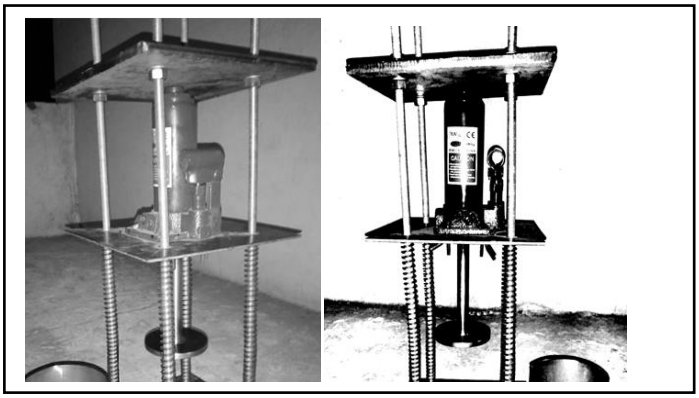
Oil extraction methods: -
1. Chemical method: - solvent, enzymes.
2. High pressure CO_2.
3. Distillation.
4. Mechanical extraction: -Hydraulic press, screw press.

Hydraulic press: - A hydraulic press is a machine press using a hydraulic cylinder to generate a compressive force. This fabricated model is very simple and easy in construction it consists of a 5-ton powered hydraulic bottle jack and a cylinder as their main components. The major advantage of this model is the parts of it are not permanently fixed they can be assembled and dis-mantled whenever necessary. It contains a cylinder in which seeds are filled through which oil is to be extracted as it is powered by a hydraulic jack as soon as the ramming begins the pressing plate comes down step by step exerting pressure on the seeds on continuing the process the seeds get compressed into cake and oil is expelled out through the passage provided.

2. METHODOLOGY

In achieving the aim of the work literature survey of various papers have been done in order to obtain an idea of effective method of expelling oil from the seeds both in the terms of cost and strength. After literature survey we came to a conclusion that hydraulic press is more effective and the product has been designed based on the formulas and the detailed drawing of the developed product has been done using the software catia v5.

3. EXPERIMENTAL PROCEDURE AND TESTS



The above present two figures represents the experimental setup of the oil extractor.
The design parameters of the model are as follows.
1.Stud:-
d=12mm.
L=625mm.
Threading =1mm.
Material= Galvonised Iron.
Stress = 200N/mm^2.
2.Spring:-
No of coils i=43.
Overall length of spring =300mm.
No of springs =4.

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Dia of coil =2mm.
Internal dia of the spring =16mm.
Thickness of coil =1mm.
Outer dia of the spring =18mm.
Material =Mild steel.
Allowable stress =56Mpa.

3.Plates:-
Material =Mild steel
Top plate Thickness=10mm
Area =250x250mm and hole dia=12mm
Middle and lower plate thickness =4mm
Area =250x250mm
Middle plate hole diameter =14mm
Lower plate hole diameter =12mm
4.Pressing plate:-
Diameter =96mm
Length =150mm
Material =mild steel
σ_t =56mpa
5.Cylinder:-
Outer dia =100mm
Inner dia=98mm
Thickness =1mm
Length =150mm
Material =Stainless steel

Design Calculations

1. Design of piston:-

$$F = \frac{\pi}{4} \times D_p^2 \times P$$

D_p =25mm
P=1.725Mpa

$$F=\frac{\pi}{4} \times 25^2 \times 1.725$$

F=846.75N

2. Design of cylinder:-

$$t = \frac{D_i}{2}\left[\left(\frac{\sigma_t + P_i}{\sigma_t - P_i}\right)^{\frac{1}{2}} - 1\right]$$

W.K.T thickness =1mm
$\sigma_{t\ ultimate} = 220mpa$
FOS =4
$\sigma_{t\ allowable} = 55mpa$
$P_i = 1.125\ mpa$
On substituting all the above values in the above equation we get
$D_i = 96.76 \cong 98mm$
$D_o = D_i + 2t$
$D_o = 100mm$
3. Load on each stud:-

$$F = \frac{\pi}{4} \times D_p^2 \times \sigma_t$$

$\sigma_{t\ ultimate} = 200mpa$
FOS=3

$$\sigma_{t\ allowable} = \frac{200}{3} = 66.67mpa.$$

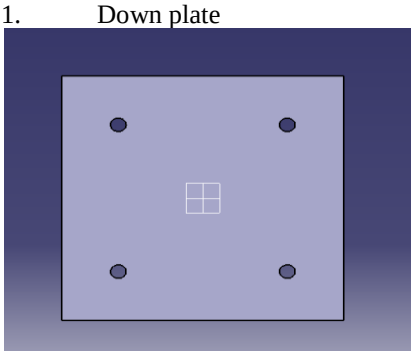
$$F=\frac{\pi}{4} \times 25^2 \times 66.67$$

F=32726.55N

4. Design of spring:-
Solid Length $L_s = n' \times d$
$L_s = 86mm.$
Spring Index $c = \frac{D}{d} = \frac{16}{2}$
C=8
Stiffness $K= \frac{4c-1}{4c-4} + \frac{0.615}{c} = \frac{4\times8-1}{4\times8-4} + \frac{0.615}{8}$
K=1.1840
Pitch = $\frac{l_o-2d}{i} = \frac{300-2\times2}{43}$
Pitch =6.88mm$\cong 7mm$
Free length $l_f = (i_p + 2d) = (43 \times 7 + 2 \times 2)$
$l_f = 305m$

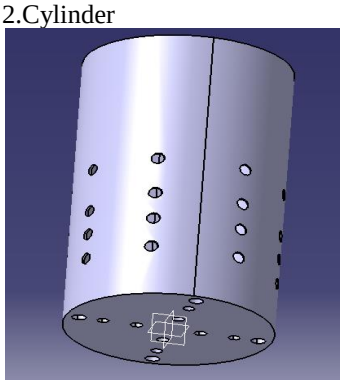
Assembly sequence

1. Down plate



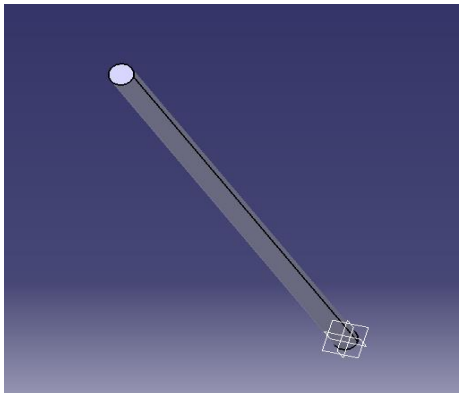
Material =Mild steel Dimensions =250x250x4mm

2.Cylinder



Outer dia =100mm Inner dia=98mm Thickness =1mm
Length =150mm Material =Stainless steel

3.Stud



Material = GI Dimensions =650x12mm

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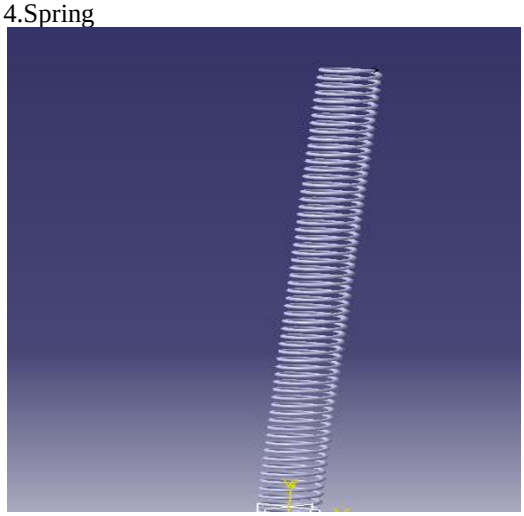
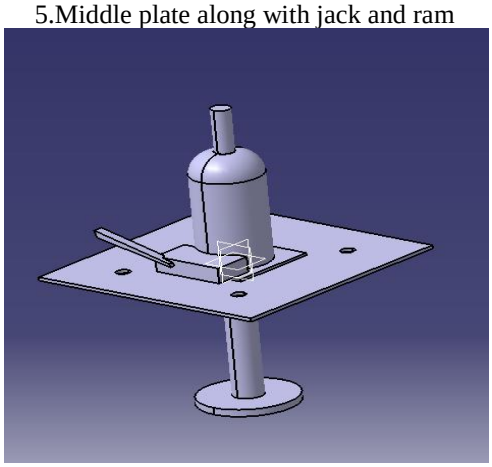
4.Spring



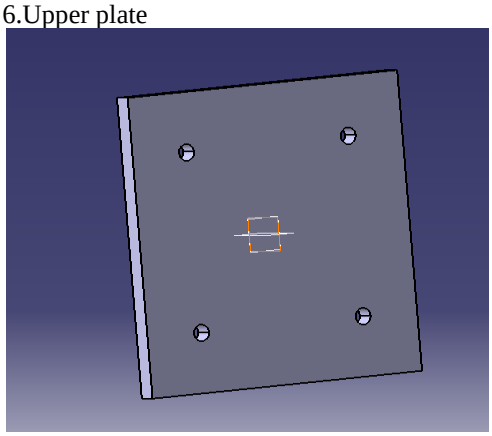
Overall length of spring =300mm.
Internal dia of the spring =16mm.
Outer dia of the spring =18mm. Material =Mild steel.

5.Middle plate along with jack and ram



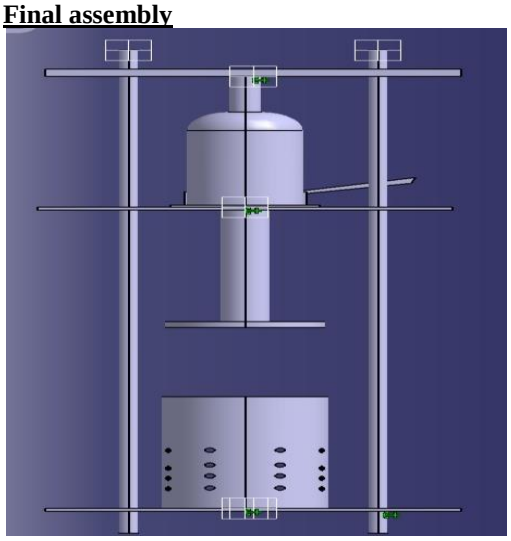
Middle plate hole diameter =14mm. Thickness =4mm.
Jack capacity =5tons. Pressure exerted by jack=1.725mpa.
Pressing plate:-Diameter =96mm Length =150m Material =mild steel

6.Upper plate



Material =Mild steel Dimensions =250x250x10mm

Final assembly



Procedure:-The procedure of the expulsion of oil from the seeds takes place as follows.

- The assembly of the equipment should be made as shown in the design part as final assembly image.
- The cylinder should be cleaned thoroughly and should be wiped cleanly with a dry cloth
- The quantity of seeds should be weighed and should be wrapped in a thin layered cloth and should be placed in the cylinder.
- The cylinder should be placed in between the middle and the lower plate along with the collecting bowl under it.
- The jack should be pumped which starts to lift the jack piston towards top pushing the pressing ram downwards.
- The pressing ram crushes the seeds and expels oil from it.
- When the release nut of the jack is activated the compression springs pushes the ram to its original position and the fresh oil expelled is collected from the collecting bowl.

4. RESULTS AND DISCUSSIONS

The tests have been performed on the two forms of Groundnut seeds that is of roasted and unroasted .And the oil yield % obtained was of 60% the graph has been plotted of "oil yield in gms Vs oil seeds in kgs".

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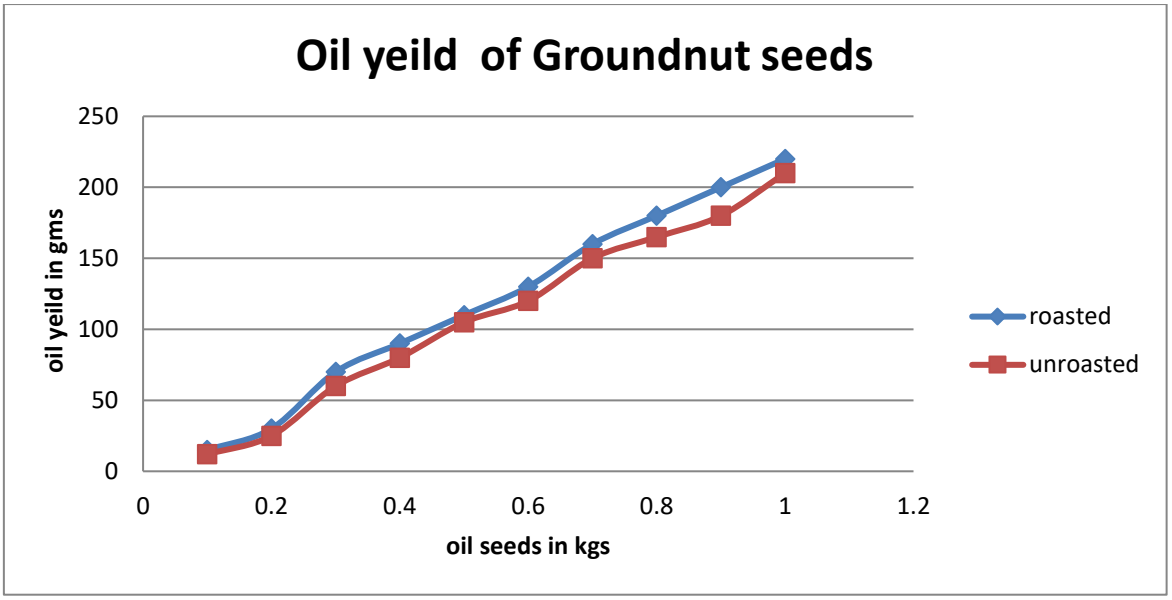

5. CONCLUSION

A domestic purpose Hydraulic press Oilexpeller has been developed. The machine is capable of pressing various kinds of seeds in their different forms i.e. roasted and unroasted seeds in home itself. All the machine parts worked effectively without any damage The overall costing of the machine has been managed to be very low that is of around INR 6000/-.

The future developments that can be made in this equipment is the up gradation of jack to 10ton or 20ton which helps in pressing the seeds more effectively with less amount of operating pressure even the equipment can be electrified by replacing hydraulic jack with motorized screw jack.

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