International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 01
January 2017

Design and Fabrication of Portable Coconut/Seed Oil Extraction Machine

Pramod Kumar N[1], Nagar Shetty[2] , Rakshith Bhat[3],Pragath Shetty[4] & Parikshith Poonja[5]

[1] *Assistant Professor, Department of Mechanical Engineering. AIET,Mijar, Moodbidri Karnataka, India*
[1] *E-mail:pramodnk90@gmail.com*
[2,3,4,5] UG students,*Mechanical Engineering. Alva's Institute of Engineering & Technology (Affiliated to VTU Belgavi, Karnataka) Mijar, Moodbidri Karnataka, India*

Abstract:

This paper aim on design and fabrication of portable Coconut/Seed oil extraction machine. The machine is light in weight which makes it portable and can be used for small scale industries and for Household oil extraction. Since this machine requires less space to move, it can be used in a more versatile manner as compared to heavy powered machines that are mounted on heavy and bulky industries. This machine can be efficient and easy to operate and maintain. The oil extracted has various applications in food, medicine, and industry. It can be used to extract around 650 to 1300ml in 1 to 2kgs of coconut thus covering more time compared to hydraulic jack machine. Design is made in such a way that easy to assemble and dissemble, it serves the dual use of work and it can be used in a more versatile manner as compared to power machines that are mounted on heavy and bulky industries.

Keywords

Oil Expeller, Oil extraction, Screw Expeller, Coconut oil, Table top oil press

1. Introduction

Today the industrial sector in India is hit badly due to lack of power and improper management in small scale production. This is the basic reason for the developing a virgin coconut oil extraction machine. Extraction machine refers both to manual and economically as a mode of daily commuting aspects as well as the use of virgin oil in a commercial activity which is the natural oil obtained from fresh coconut by various extraction methods as well as being efficient in operation and durable.
This paper is deals with design and fabricate virgin oil extraction machine using simple designs and mechanism is carried out. It is used in small scale and mass production for utilization of advance mechanism. The machine is efficient in both biological and mechanical terms.

The design of the table top oil expeller needs to be suitable for small-medium businesses where the total cost of setting up and running the machine is low. Although it is at a low cost but yet it must be very efficient in expelling oil. The profitability of oil processing depends on reducing the capital and operating costs as much as possible, and at the same time maximizing the income from the sale of oil and by-products. A careful study of all costs should be undertaken before setting up a Production unit. A labor saving device, it can be used to extract around 650 to 1300ml in 1 to 2kgs of coconut thus covering more time compared to hydraulic jack machine. Easy to assemble and dissemble, it serves the dual use of work

2. Traditional Oil Extraction Methods

Traditional Oil Extraction Methods are Manual presses, Ram Press, Ghani ,Solvent extraction, In manual method Oil can be extracted by pressing softer oilseeds and nuts, such as groundnuts and sheal nuts, whereas harder, more fibrous materials such as copra and sunflower seed can be processed using ghanis. Pulped or ground material is loaded into a manual or hydraulic press to squeeze out the oil-water emulsion. Ram press extraction method is extraction of oil using long pivoted lever moves a piston backwards and forwards inside a cylindrical cage constructed from metal bars spaced to allow the passage of oil. At one end of the piston's stroke, it opens an entry port from the seed hopper so that seed enters the press cage. When the piston is moved forward, the entry port is closed and the oilseed is

compressed in the cage. As a result, oil is expelled from the oilseed and emerges through the gaps in the cage. Compressed seed is pushed out through a circular gap at the end of the cage. The ghani consists of a large mortar and pestle, the mortar being fixed in the ground and the pestle being moved within the mortar by animal traction (donkey or mule) or (more commonly) a motor. Oilseeds are placed in the mortar and the pestle grinds the material to remove the oil. The oil runs out of a hole in the bottom of the mortar and the cake is scooped out by hand. This method is slow and requires two animals, replacing the tired one with another after about 3-4 hours of work. Whereas in solvent exaction method plants use hexane as a solvent to extract oil from oilseed cake. These plants are expensive and only suitable for large volumes which justify the capital cost of equipment. Where large amounts of oilseed cake are available, solvent extraction becomes a commercially-viable option to extract the residual oil left in the cake and leave an almost oil-free powder known as oilseed meal. Both cake and meal are incorporated in animal feeds.

3. Design Requirements

The oil extraction system was developed as a means to convert coconuts into their main items of commerce namely, oil and cake, right where the coconut comes from the coconut plantation. Because of this objective, the oil extraction machines were also designed so they can be owned and operated by the people who planted and make their living out of the coconut tree. Even seeds of various varieties can be used to produce oil, certain tests have been conducted on the machine and it has been proved that our machine produces adequate amount of oil. There, It is constrained to make the system simple to operate and maintain, reasonably acceptable to the community and the environment, relatively inexpensive to own and suited to household applications. The design was targeted towards achieving the following, high oil yield, high extraction efficiency, high oil yield and low cost construction of oil expeller. Consideration was also given for a strong main frame to ensure structural stability and strong support for the machine.

4. Design of Oil Expeller

An oil expeller is a screw-type machine that presses oil seeds through a caged barrel-like cavity. Expeller pressing (also called oil pressing) is a mechanical method for extracting oil from raw materials. The raw materials are squeezed under high pressure in a single step.

This extraction machine consists of a cylindrical chamber in which screw crusher rotates; a high speed mixer is set up for grinding the coconut into smaller pieces and a heating unit for heating the chamber. The heating unit is fixed to the chamber and it is switched on first so that the temperature increases inside the chamber which results in efficient release of oil. The screw crusher can be operated by using a Motor. The motor is connected to the gearbox through coupling and the screw shaft is connected to the gearbox. The screw shaft is connected to gearbox though a bush and to tighten the grip of this bush on the shaft, two sets of screws are drilled into the bush and it touches the shaft. This way the screw does not allow the shaft to slip from the bush.

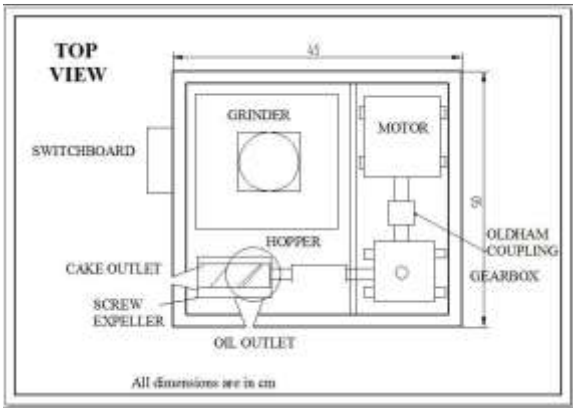

Figure1. Schematic diagram of Expeller Machine

4.1 Motor, Gear Box & Body of Expeller

Figure2. Arrangement of Gear Box and Motor

One of the most common electrical motor used in most applications which is known as induction motor. This motor is also called as asynchronous motor because it runs at a speed less than its synchronous speed. For the table top oil expeller an AC single phase motor with 0.5HP rating is used which runs at speed of 1450rpm. Gear box with 50:1

speed reduction is used. The Gear box is connected to motor perpendicularly.

4.2 Screw Press

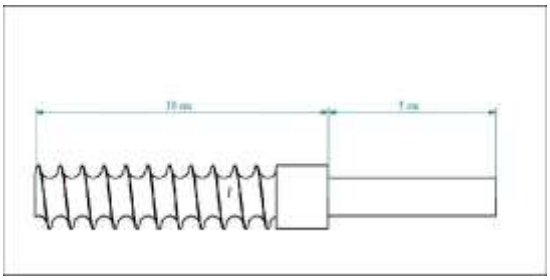

Figure3. Screw Specifications

This is the main part of the expeller. It consists of helical threads that push the particles further inside the chamber or barrel till the pressure increases and oil is released. It is placed inside a cylindrical barrel and its outer shaft is connected to the gearbox via coupling. The seeds are continuously fed to the expeller, which grinds, crushed and presses the oil out as it passes through the machine. The pressure exerted from the screw crushes and ruptures the oil cells in the product and oil flows through the opening in the casing and is collected in a tray underneath. A stainless steel screw is used for the oil extraction machine with screw length is 100mm and with diameter 20mm.

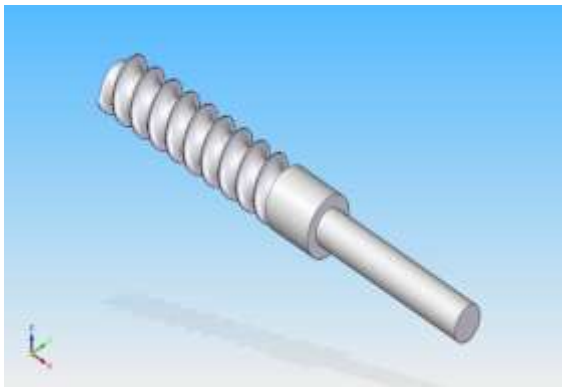

Figure4. Model of Screw

Figure5. Fabricated Screw

4.3 Casing & body of Expeller

Figure6. Casing and Body of Expeller

It is made using high thickness G I sheet which is in a rectangular shaped and it is made in such a way that it fits within the framework and covers all the components of the machine. Hopper is use to feed the copra/seeds inside the chamber to extract the oil. It also controls quantity of seed to supply for crushing. Hopper allows the seeds to flow in a continuous manner into the pressing room and also the hopper acts as a storage container and it does not allow the seeds to fall out.

4.4 Pressing Barrel

It is of cylindrical type and it is made up of MS iron and it houses the screw in it. The distance between the screw thread and inner walls of the pressing room is kept less so that more oil is extracted due to pressure build up inside the barrel. The distance between screw and pressing room is of 2mm and is made of mild steel.

4.5 Heating Coil for Extractor

Figure7. Pressing Barrel with Heating Unit

The Pressing room in which the screw rotates has to be preheated first for 10 minutes so as to accelerate the release of oil .For heating purpose, Solder gun has been used because the temperature reaches to around 70 to 90 degree Celsius.

Figure8. Portable Oil Extraction Unit

5. Performance Calculations

Resistance offered by the motor winding
R = V/I = 240/1.9 = 126.3 Ohms…….....(1)
Power input to the motor
(Pin)=1.9 x 240 = 456 watts ……(2)
Power output from the motor
Pout= T x w =136 watts ……..…(3)

Efficiency of motor 30% and for the motor torque produced is 0.91 N-m which is sufficient to expel the oil from dry seeds

6. Performance of Oil Extractor

1) With just 120 grams of Dry Copra, we extracted around 70 ml of oil in 25 minutes. Hence our machine can produce about 500 to 600 ml of oil with just 1kg of copra.
2) With 150 grams of Peanut, we extracted about 60 ml of oil in 25 minutes. Hence 1kg of groundnut can produce 400 to 500 ml of oil.

Table 1. Performance evaluation of the Oil extraction machine

Type	Feed rate (gm/min)	Pressing time	Initial Weight of seeds (gm)	Final weight of cake (gm)	Yield of oil (gm)
Peanut	6	25	150	95.5	56.30
Copra	5	30	120	51	68.5
Almonds	6	25	150	86	80

Figure9. Extracted Peenut Oil And Its Cake

Figure10. Extracted Coconut Oil And Its Cake

Figure11. Extracted Almond Oil And Its Cake

7. Efficiency of Oil extractor

Efficiency, percentage of the oil obtained from the extraction machine

Extraction efficiency E,

E = Y/Co x 100%

Where Y = oil yield in percentage.

Co = oil content of Seeds/Nuts/Copra

The oil yield Y is calculated from

Y = (W1 - W2)/ W1 x 100%

Where W1 = Initial weight of seeds (Before extracting)

W2 = weight of cake (after extracting)

1)Considering Value of Almonds Table 1
W1 = (150 – 86)/ 150 x 100 = 42%
Efficiency of the machine is
E = Y/Co x 100 = (0.42/0.49) x 100 = 85% ['Co' for almonds is 45 – 50%]

2) Considering value of peanut from Table 1,
W1 = (150 – 95.5)/150 x 100 = 36%

Efficiency of the machine is
E = Y/Co x 100 = 0.36/0.47 x 100 = 76% ['Co' for Peanuts is 45 – 55%]

3) Considering value of Copra from Table1,
W1 = (120 – 51)/120 x 100 = 57.5%

E = Y/Co x 100 = 0.57/0.70 x 100 = 81% ['Co' for Copra is 65 - 72%]

8. Effect of Clearance On Fineness Of Cake

The degree of fineness of the ground cake depends on the clearance between the conical elector and the extraction chamber. It was observed that the extracted cake at 1.0mm was finest. This observation is due to the fact that as the flow area decreases as the pressure exerted increases. This aids the grinding and compression of the cake against extraction chamber walls, thus producing a fine cake. On the other hand, when the flow area increases, the pressure exerted on the cake becomes relatively small, thus leading to coarse cake.

9. Conclusion

Oil extraction machine was designed, constructed, using locally available and easily accessible materials, and tested for oil extraction. The expeller was simple enough for local fabrication, operation, repair and maintenance. The oil produced will be at affordable costs for consumers and also provide cake for livestock feed mill. The machine has a simple construction and is light in weight which makes it portable and can be used for both domestic and commercial purposes. It can be commercially produced to supply a portable machine to produce coconut/seeds oil in a reliable way and to compete in the market.

10. Acknowledgements

This work was supported in part by a grant from the KSCST, Bangalore for giving us the opportunity to showcase our project in the exhibition and also for providing the financial support. We thank our Principal & Management of Alva's Education Foundation, Moodbidri for providing an environment which helped us in completing our project.

11. References

[i] Deli S, Farah Masturah, Tajul Aris, and Wan Nadia,"The effects of physical parameters of a screw press machine on oil yield".

[ii] Sreenatha Reddy, Dr V Pandurangadu and I Srinivas, "Mini oil expeller"

[iii] V. S. Khangar and Dr. S. B. Jaju, "Methodologies used for failure analysis"

[iv] International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015, ISSN 2091-2730271

[v] Akerele O. V. and *Ejiko, "Design and Construction of Groundnut Oil Expeller" International Journal Of Engineering And Computer Science ISSN: 2319-7242 Volume 4 Issue 6 June 2015, Department of Mechanical Engineering, The Federal Polytechnic Ado-Ekiti, Ekiti State

[vi] Anzaldo, F.E. et al, 1985, "Coconut Water as Intravenous Fluid",Philippine Journal of Coconut Studies, Vol 10. No. 1, as cited by Banzon et al, 1990. Coconut as Food. PCRDF.

[vii] Gunstone, F. D. and Norris, F. A.(1983), "Lipids in food Chemistry", Biochemistry and Technology, Pergamon Press

[viii] Mangesh A Pachkawade 1, Prof.Pawan A Chandak2,"A Review on design and analysis of oil expeller spares" Volume 1, Issue 5, December 2013 International Journal of Research in Advent Technology ,Department of Mechanical Engineering Department ,Datta Meghe Insitute of Engineering,Technology & Research.

[ix] Tony Swetman, "Oil extraction" of Practical Action the Schumacher Centre for Technology and Development Bourton-on-Dunsmore Rugby, Warwickshire, CV23 9QZ.

About Author

Mr.Pramod Kumar N got his BE in Mechanical Engineering in 2012 received from Vivekananda College of Engineering and Technology, Puttur, Karnataka and received M. Tech. in Product Design and Manufacturing (PDM) from KVG college of Engineering, Sullia, Karnataka in 2014, Presently Serving as Asst.Professor, Department of Mechanical Engineering, Alva's Institute of Engineering & Technology, Moodbidri, Mangalore, He has an academic experience of about 3years. He has publications in international journals covering the area of machining & experiments on dynamic tool wear and thermal analysis of single point cutting tool, Polymer composite materials. His area of specialization and interest are Product design and Manufacturing, Design for manufacturing, Computer assisted machining.