

Extraction of Cutting oil by Centrifugal Machine

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Abstract— With the various part production companies establishing these days, one can witness a large amount of chips production as well. Being an integrated part of the production, cutting fluids plays an important role as coolant. The chips produced as bi-product are carried out with cutting oil present with them. In order to extract excess oil from chips, usually drain by gravity containers is used. The application of centrifugal machine in order to extract every single drop of cutting oil for refilling in collecting tank can save a remarkable amount of cost and eventually increase production with limited cutting oil.

Index Terms— Centrifugal effect, Centrifugal machine, Chips production, Extraction of cutting oil from chips, Reuse of cutting oil, Drying of chips, Chips after production.

1 INTRODUCTION

The centrifuge machine is playing an important role in other industries. Centrifuge is a type of mechanism which can work both on the centripetal and centrifugal aspects as per the requirement. It is defined as an electromechanical structure consisting of motor, cylindrical drum, proper mounting to avoid vibrations that's been produced by the rotational effect of the machine. Centrifugal effect is the outward force acting perpendicular to the axis of rotation, whereas centripetal force acts radially inward to the axis of rotation. Centrifugal is used to separate two different components, whereas centripetal is used to mix the two different components being in any state of solid, liquid or gases.

The need of this project mainly revolves around separating/extracting of oil from the chips which results to the use of centrifugal effect. In order to carry out the same, centrifuge is used. With the wide application of technical and nontechnical fields of life it has proven to be a setting an example.

There are several industries like dairy where centrifuge is used to churn the milk and take out fatty cream separate from milk. As the density of cream is lower that of milk it floats on the surface and milk settles down at the bottom that makes an easy process to separate the cream from milk. In medical industries also use of centrifuge can be seen to separate sample from a mixed compound.

A wide range of structural size and design of centrifuges are available these days like small, medium and large centrifuges. Depending on the use and capacity as per requirement the centrifuge can be specified and purchased by the industry.

Small centrifuges are usually seen in scientific laboratories where the result should be precisely observed. With a controlled atmosphere and supply desired rpm is able to be achieved. Medium centrifuges are used even in small scale industries and food processing industries, depending on the quantity that is used for the separation of the same. Large sized centrifuges are common in bulk production industries, that sets a huge quantity to be mixed or separated.

As mentioned before, both the effects – centrifugal and centripetal can be observed in a centrifuge. If two different materials are to be

mixed then the rpm should be less and the structure should be concentrated towards the centroid of the structure so the mixture comes to the centre like that of a cement mixer machine. On the other hand a centrifuge tend to throw the lower density material away from the rotational axis which hits the curvature surface and drop down to get separated from the initial mixture. The acceleration of the particle having more density than the other is set to rest at the bottom where as the lesser density material tends to float. Rotations of the centrifuge play a key role in obtaining the desired outcome.

The following are some important specifications that are needed to be specified before buying a centrifuge:

- Diameter of the basket- it helps in determining the internal area of the basket where the mixture is supposed to be kept.
- Height of the basket- it tells about the length of basket that can be used for the process.
- Working capacity- it is the amount that can be filled the basket to carry out the particular operation.
- Speed of the basket- it defines at which rate the centrifuge is going to rotate.
- Filtration area- it tells about the area with sieve so that the oil we are extracting can be stained before coming from the outlet.
- Overall dimension of the machine like width, height and length should be known to provide with ample space for the installation of the machine.

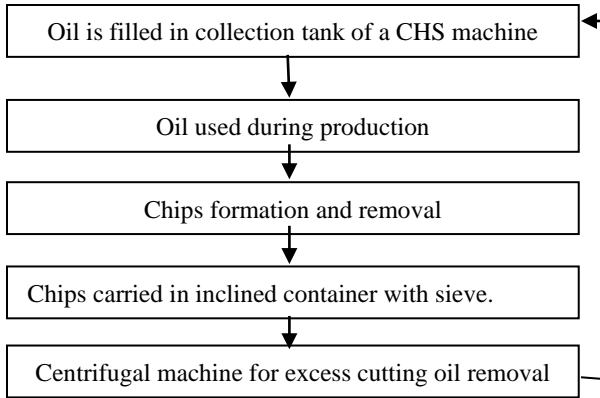
The various models of the centrifuges are present these days in the markets that are performing well as per the industries requirement. Multipurpose feature of the centrifuge makes it own a stand in the market scenario.

As the dripping loss of the company can be saved it will eventually pay contribution to the profit of the company and even avoid polluting the flora and fauna of the planet.

2 METHODOLOGY

The centrifuge machine is used to carry out the excess oil extraction

process from chips produced as bi- product during part production.
 The following procedure has been carried out,



Once the top-up of cutting oil is done in the collecting tank and is supplied as coolant to serve the purpose for production. Production of chips takes place, taking out the chips into inclined wedge containers will carry some oil that can be collected by the tap provided underneath. And the same oil is refilled back to the collecting tank of the machine.

The chips are then discarded as it is.

With the centrifugal machine in use the chips can be filled in the centrifugal machine drum and will be rotated at certain rpm for sometimes and then the oil and then oil can be collected from the bottom discharge tube provided and dried chips can be carried out. As the centrifuge itself is provided with proper inbuilt structures with a sieve that can help filter the oil from chips, similarly like a washing machine.

2.1 Working



fig(a) Bottom Driven Centrifuge

It is a 3 point pendulum suspension centrifuge:

The chips carrying the cutting oil are filled in the cylindrical drum by opening the lid resting on top. Once the chips are filled in the machine and the machine is powered for a period of time. The rotations start to enforces the chips to move with high velocity and

due to which oil is tangentially hitting to the inner sieve and then settling down to come out by an outlet section and the centrifuge is left with dried chips in it.

The lid is then open to take out the dried chips and the next batch of chips can be sent in the machine for the same process.

The vibration of the Centrifuge is isolated with the help of springs & pendulum bolt arrangement.

Technical specification for Bottom Driven Centrifuge:

- Model = NSI36
- Basket Diameter = 915mm
- Basket Height = 457mm
- Working Capacity = 165litres
- Basket Speed = 1000rpm
- Centrifugal Force = 511G
- Filtration Area = 1.30 m²
- Motor Power = 7.5 hp
- Overall dimensions of the machine
- Length on the motor side = 1900mm
- Width = 1900mm
- Height = 1200mm

3 CALCULATIONS

The calculation below is in regard by taking one machine in consideration and deriving for a bulk of 30 other machine working at similar conditions.

- Oil used: HICUT CASTLE VG22
- Part produced: Pin synchronizer (Part No: 01F33150705)
- Raw material: Stainless Steel
- Material grade: SAE10B42
- Rods per shift=12 rods
- Dimension of each rod:

 - Diameter: 19mm
 - Length: 3000mm

- Parts produced per rod: 34 parts
- Weight of each part produced: 80gms
- Parts produced per shift: 400 parts
- Total weight of rod= 6700gms
- Weight of part produced from each rod=34*80=2720gms
- Weight of chips per rod per shift = total weight of rod – total weight of part produced – weight of leftover rod
- = 6700gms – 2720gms – 536gms
- =3444gms
- Weight of chips produced per shift = 3.4kgs*12rods =40.8kgs
- Weight of chips produced in a day (3shifts) = 40.8kgs*3
- =120kgs

Oil collection from one machine

Months	Parts produced	Weight of chips produced (kgs)	Oil collected in inclined container	Oil collected via centrifugal

			(ltrs)	machine (ltrs)
November	36,000	3,600	864-880	140-170
December	37,200	3,720	890-900	150-180
January	37,200	3,720	890-900	150-180
February	34,800	3,480	835-850	140-170

Table. (5.1) Production data.

As per observation,

Total number of machines using cutting oil = 30 machines.

Oil collected through centrifugal machines = 4200ltrs to 5100ltrs.

As we know,

1 – Barrel oil = 120 liters.

Cost of 1 – Barrel oil = Rs 18,000.

Number of Barrels saved by centrifugal machine = 35 to 40 barrels.

Cost saved by centrifugal machine in a month = Rs. 6, 30,000 –

Rs. 7, 20,000

4 LITERATURE REVIEW

[1] Chukwunonso Nwogu in the year 2015 on the topic of “Design and Development of an Industrial centrifuge for small and Medium Scaled Industries”-Centrifuge it is type of equipment or device which is used for separating two mixture in the industries that can in liquid state or gaseous state depending on the density, they are developed and designed based on the capacity. The electrical and mechanical component used in the manufacturing of the centrifuge machine are electrical motor can also be called as driver, rigid frame, rotating wheel, vessel which is known as sedimentation vessel there are around three sedimentation vessel and a centrally mounted shaft. As centrifuge wheel is major load carrying member in the centrifuge machine hence, stress analysis was carried out on the solidworks. And it was found that the factor of safety 5.12 for load of 331.4N. the centrifuge machine was designed in such way it can withstand the vibration caused by the rotating masses. Based on the performance test was conducted it was found that the specific energy consumption and the mixture optimal separation time 207.6kj/kg and 29.5 minutes. Thus, the centrifuge can be used for various number of application in small and medium scale industries.

[2] Centrifugation Techniques David Rickwood, University of Essex, Colchester, UK 2001-centrifuge type of device has major application in the medical and pharmaceutical industries. centrifugation uses the centrifugal force generated in the spinning rotor. And with help of rotary action it separates the biological particle, such as cells, viruses, sub-cellular organelles, macromolecules (principally proteins and nucleic acids) and macromolecular complexes (such as ribonucleoproteins and lipoproteins). Basically there three mainly used method for the separation they are known as differential pelleting, rate-zonal centrifugation and

isopycnic centrifugation. Differential pelleting and rate-zonal centrifugation method separate particle primarily on bases of their density. The choice of the centrifugation method in the biological particle separation are totally based on the nature of the particle.

[3] Research centrifuge advanced tool separation Mahajan Ashwini*, Prof. B.V. Jain. Dr Suraj Sarode Department of Pharmaceutics Smt. S. S. Patil college of Pharmacy, Chopda, dist- Jalgaon (MH)-centrifuge type of equipment are the major and critical equipment used for the laboratory. Purpose of this research and study was to study the centrifuge in more detail, its applications, use in the different branches and its silent features. Basically there are two type research is been carried out one research centrifuge study here revolutionary research centrifuge and another one is microprocessor research centrifuge. A centrifuge is device which use to separate particle from the solution through using rotor. As this centrifuge are used in the medical and pharmaceutical in industries the particles in the biology usually cells, sub cellular organelles or large molecules, all of which biology they are referred to here as a particle. There are two types of centrifuge procedures; one is preparative, the purpose of which is to isolate specific particles, and the other is analytical, which involves in measuring the physical properties of the sedimenting particle. According to revolutionary research on centrifuge having silent features more than other centrifuge.

[4] Stefan Szepessy 2018 (Low Energy Consumption of High Speed Centrifuges)-A remarkable reduction of the energy consumption of high speed centrifuge was obtained by the following several design changes, while still maintaining separation capacity. The reduction is very important and necessary for making some application commercially interesting. For example large volume flow rates in the growing biopharma industries. They are achieved or obtained varying the flow paths of the rotor. For example reducing the outlet radius so through this variation the angular momentum losses can be minimize and lowering the pressure drop of the internal flow. Further, removing air outside the rotor can reduce the aerodynamic losses, and using direct drive motor losses can be fixed by gear or belt drives were eliminated. In this way, on an average energy reduction of 50% was obtained in the study. from industry standards 0.7 to 1.5 kw/m³/h, to 0.5 and in the best case down to 0.25.

5. RESULT

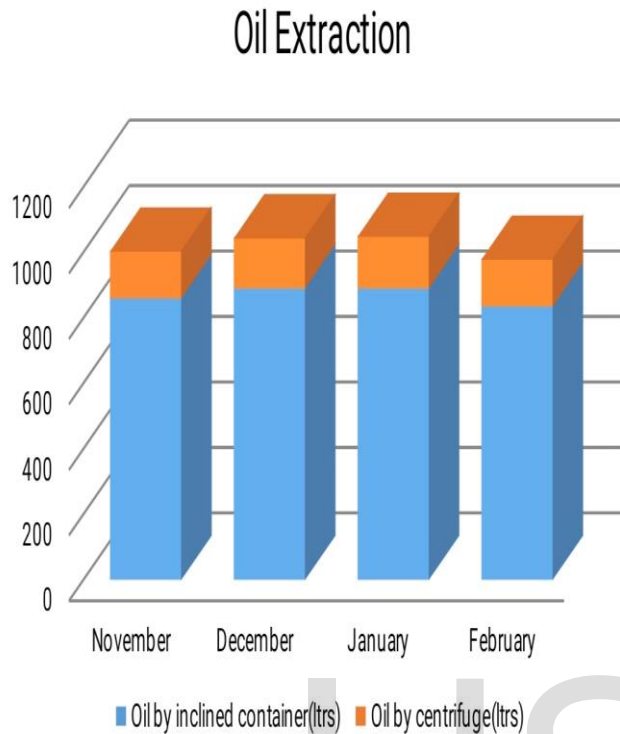


Fig (5.1) Bar graph

Graph:

X axis denotes the month (November 2019– February 2020).

Y axis denotes the extracted oil in liters.

Blue bar shows the oil extracted by conventional method.

Orange bar shows the oil extracted by centrifuge.

The above bar graph shows the data of re-used oil by conventional (inclined wedge containers or gravity drain method) and oil extracted with the help of centrifuge.

It can be clearly seen that a noticeable amount of oil by centrifuge (orange bar) was left as waste. With respect to the graph it may appear less but when mass production comes into picture a large sum of oil can be re-used and a large sum of money can be saved.

Centrifuge machine is able to save around 35 to 40 barrels of oil worth Rs. 6, 30,000 – Rs. 7, 20,000 for this particular conditions, it may vary from industry to industry.

6 CONCLUSION

According to this research we have concluded that it is unfortunate, that many companies don't pay much attention towards such kind of issues and in return they are left to drip out the profits of the company. Using this process company can save remarkable amount of oil which is in return can

enhance the production and increase the profit of the company and can control the chemical waste by reusing the oil, instead of disposal of used oil. This process is most effective method to reuse the cutting oil in all production industries. And also, we have concluded that there is some percent of cutting oil in production process get evaporated. This does not have any solution in production industries. So, this can also be a topic to carry out future research to reuse the cutting oil from evaporation.

7 ACKNOWLEDGMENT

The authors wish to present the gratitude towards faculty of School of Mechanical Engineering REVA University.

We are thankful to Mr. Nagaraja, Maintenance Head, Maini Industries Limited, Bangalore for his constant support.

We are thankful to our friends and family for constant motivation and patience.

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