CHIP CENTRIFUGE AUTOMATION ON CROWN GEAR LINE

H.Bahuruteen Ali Ahamadu a*, M.Sudarsan b, V.Vijayagoutham b, M.Karthik Raj b, D.Rajesh Kumar b

a Assistant Professor, Department of Mechanical Engineering, Velammal Institute of Technology, Chennai-601204.
b Department of Mechanical Engineering, Velammal Institute of Technology, Chennai -601204.

*Corresponding Author
bahu.ceg@gmail.com
(H.Bahuruteen Ali Ahamadu)
Tel.: +918056173887

Received : 10-10-2018
Accepted : 15-11-2018

ABSTRACT: The ultimate need for automation has been tremendously increasing in our day to day life to complete our difficult tasks with ease. Moreover automation has entered in industries a century ago. It helped several industries in satisfying the need of people and helped in developing their nations. Nowadays some industries are completely automated to meet the growing demand. And now automation of simple works may also save a lot while calculating it in a large scale. So, we have planned to automate the separation of lubricant from the chip produced during the machining of crown gears. Since the chips containing lubricants are collected in a separate container and then processed then again the lubricant are restored and the chips are dumped. This leads to wastage of time and a separate labor is required to do this process. To overcome this we have designed a model that automatically separates the lubricant and restores it to the machine and dumps the waste.

Keywords: Automation, Centrifuge, Lubricant.

1 Introduction

In industries various levels of changes are made to minimize the work done by man so that to produce the product with ease and quick. Such way in our project we have planned to minimize the manpower required for carrying the chips containing lubricants to the chip processors by using a series of components and mechanisms. With our project we have the process can be done easily and the level of separation of lubricant from the chips will increase. At present a separate labor is required at the end of each shift to carry the chips into the centrifuge and also the capacity of processing the chips by the centrifuge is limited it took a lot of time to process it. And also while transferring the chips to various containers there will be a considerable amount of loss of lubricant. And to overcome all these problems we have planned to automate the process so that the manpower can be established more efficiently and in the right place.

2. COMPONENTS

2.1 Collecting Box

Collecting Box is a cubic box which is used to collect the chips containing oil from the conveyor into the centrifuge. This box is made of stainless steel and will be in continuous motion. This motion of this collecting box is controlled by a pneumatic piston and a wire rope sling. Dimensions of the collecting box are

- Length=250mm
- Breadth=100mm
- Height=180mm

Total volume of the collecting box is 4500CC.

Fig 1 Collecting Box
2.2 Pneumatic Piston

In this project we have employed two pneumatic pistons. One for the forward and backward movement of the collecting box. And another one for the opening and closing of the centrifuge door after the completion of processing of chips. Here a separate compressor is used to supply compressed air to the pneumatic pistons. Each pneumatic piston works under a pressure of 5 bars.

![Pneumatic Piston](image)

2.3 Hydraulic Piston

Hydraulic pistons get their power from pressurized hydraulic fluid. Hydraulic piston is known for its heavy load carrying capacity. This piston is used to lift the centrifuge to a certain height to dump the processed chips into the dumping containers. Thus in our project hydraulic piston is used in the up and down motion of the centrifuge.

![Hydraulic Piston](image)

2.4 Wire Rope Sling

Wire rope is rope like body which has several strands of metal wire twisted one over the other forming a composite rope. Wire rope slings are provided with a counter weight which is used to carry the load provided. In our project it is used to tilt the collecting box to an angle of 121 degrees.

![Wire Rope Sling](image)

2.5 Stepper Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. It is used in the forward and the reverse motion of the pneumatic piston attached to the collecting box.

2.6 Sensors

There are totally two sensors employed in our system. They are:

- Level sensor
- Photo sensor

2.7 Limit Switch

Limit switch is an electro-mechanical device which has actuator which is mechanically connected to a series of operations. When the object comes in contact with the actuator it initiates various operations linked to it. Here it is used to control the hydraulic piston used in lifting the centrifuge. Level sensor is used to measure the level up to which the chips are filled in the collecting box. Once the box is filled it stops the conveyor from taking more chips into the box. Photo sensor is used to detect whether the collecting box is present directly under the conveyor. Once the collecting box returns after dumping the chips into the conveyor it senses whether the box reaches its origin position and again commands the conveyor to dump the chips into the collecting box.
2.8 Programmable Logic Controller

A programmable logic controller or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes. They can be designed for multiple arrangements of digital and analog I/O, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. The movement of the chip collector, actions of the centrifuge, time for the sequence of operations is controlled by PLC.

3. Tilting Mechanism

In our project this tilting mechanism plays a major role in transferring the unprocessed chips from the collecting box to the centrifuge. This process is achieved with the help of wire rope sling. The wire rope sling is tied to the collecting box in the front side and passes at the bottom of it and connects to the counter weight. The ropes have a particular length and after which the counter weight pulls the box backwards. Due to the pull force the box starts moving downwards thus it are tilted so that the chips are transferred from the box to the centrifuge. This is the tilting mechanism used in our system.

4. Working

The operation starts with the magnetic conveyor leaving the chips inside the collecting box. Once the collecting box gets filled the level sensor indicates it and the PLC initiates the stepper motor which helps the pneumatic piston in moving the box forward to the centrifuge. When the collecting box moves due to the counter weight in the wire rope sling will tilt the collecting box by whip the chips from the collecting box is poured into the centrifuge. After the chips are totally dumped into the centrifuge the stepper motor again rotates bringing back the collecting box in the original position. Now the centrifuge starts rotating and thus by the centrifugal force it separates oil from the chips and the oil is sent back to the machine. When the centrifuge completes the processing of chips through the limit switch the hydraulic piston is activated. Then by the hydraulic movement the centrifuge is lifted and the processed chips are dumped into the dumping can. The centrifuge is provided with a door which is controlled by the pneumatic piston. Thus is the process by which the oil is removed from the chip and dumped automatically.

5. Calculation

The basic characteristics of the machine that produces the chips are given below:

- Machining of 1 mould into a gear produces totally 2.4 Kg of chips.
- Time taken for machining 1 mould is 5 minutes.
- The collecting box has a capacity of 3 Kg.
- The capacity of centrifuge is 6 Kg.
- RPM is 1440.
- Diameter of tool is 5 mm.

Total time taken for filling of collecting box is

\[= \left(\frac{\text{Time taken for machining 1 mould \times Capacity of collecting box}}{\text{Chips produced by 1 mould.}}\right)/2.4 = 6.25\text{mins.}\]

Thus the duration of collection is about 6mins 15secs.

Material Removal Rate= \(\frac{F \times D \times W}{1000}\) CC/min

\(F = \) Feed rate mm/min.
D= Depth of cut mm.
W= Width of cut mm.

Feed rate= RPM x Tool Diameter x π
Feed Rate= \((1440 \times 5 \times \pi) = 163440\) mm/min.

\[
MRR = \frac{163440 \times 4.2 \times 7.5}{1000} = 712.51 \text{ CC/min.}
\]

Amount of chips collected in 6.25mins are=
\[(712.513 \times 6.25) = 4453.2\text{CC} \text{ which is almost the capacity of the collecting box (4500CC).}\]

6. Conclusion

Due to the automation of this process three shift works for manual cleaning of chips are reduced and a labor can be utilized efficiently. And by this the same work done manually can be easily done automatically.

References


