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Design of a Rotary Die Cutter for Production of Complex Seals and Improvement in Delamination Process.

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Abstract— *Blanking operation is used for the production of seals (wads). Previously blanking operation was carried out by using gravity as a force to blank out the seals. A rotary die cutter has to be designed as manufacturing of complex seals is not possible on traditional machines since they exert large amount of force on the laminated sheet. Blanking operations also have a huge amount of scrap left which cannot be recycled together as it consists of aluminium foil and paper cardboard. Thus in order to tackle this issue, a delamination machine needs to be designed.A seals manufacturing company was selected for this study. The main aim of this project is to design a rotary die cutter for production of complex seals and also improvement in delamination process is desired as it will help in recycling the scrap.*

Keywords—blanking operation , complex seals , delamination , recycling , rotary die cutter .

I. INTRODUCTION

Lamination is the technique/process of manufacturing a material in multiple layers, so that the composite material achieves improved strength, stability, sound insulation, appearance, or other properties from the use of the differing materials. A laminate is a permanently assembled object created using heat, pressure, welding, or gluing. The project work presented in this report is based on improvement of a machine such that it can easily delaminate the seals (wads). The process involves heating. PID controller is used to control the temperature variation. Apart from this productivity of complex seals are required by the company for which a roller die cutter with designated complex design has to be fabricated. Arrangement of gear & rollers, speed will be implemented in systematic manner in order to achieve improved productivity.

A long sheet or web of material will be fed through the press into an area known as a "station" which holds a rotary tool that will cut out shapes, make perforations or creases, or even cut the sheet or web into smaller parts. A series of gears will force the die to rotate at the same speed as the rest of the press, ensuring that any cuts the die makes line up with the printing on the material. The machines used for this process can incorporate multiple "stations" that die cut a particular shape in the material. In each of these stations lie one or more of these geared tools or printing cylinders, and some machines use automatic eye registration to make sure the cuts and/or printing are lined up with one another when lower tolerances are required.

1.1 Project Objective: -

After researching many journals and patents we have decided to follow these necessary things,

a) In order to achieve blanking of complex dies, we have to design a rotary die cutter with considering various factor such as material selection and withstanding wear and tear. We also have to maintain proper pressure while punching operation to avoid wear and tear and to have a proper blanking action.
b) In order to achieve delamination process, we have to design a guide way in order to avoid slippage of the scrap sheet. We also have to stabilize the temperature of roller using PID controller and to find the optimum speed to get the proper output and efficiency.

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II. PROBLEM DEFINATION

2.1 Problem statement: -

a) Problem Definition 1:

After visiting the company for several times at Maauli Associates, there was a problem for production of complex seals as there were no special purpose machine were present which could carry out such kind of task. Due to which there was a chances of loss of order for the company as their clients were demanding such kind of seals. The company requirement was to design a rotary die cutter and its mechanism to perform blanking operation for production of complex seals (wads).

b) Problem Definition 2:

At Maauli Associates there was also a problem found that the company was unable to solve the problem of recycling the scrap which would left behind after the production of seals takes place. They had to keep these scrap as part of inventory but keeping it would not be beneficial. With further digging into the matter following causes were identified; Lack of information regarding temperature required to separate board and aluminum foil without burning it also the sheets had holes punched out already . Removal of foil was difficult to carry out without any breakage due to induced strain. In order to perform the delamination task smoothly and efficiently planning for optimum speed of roller was required.

2.2 Objective:

a) For achieving Blanking of Complex Dies:

- To design a rotary die cutter with considering various factor such as material selection and withstanding wear and tear.
- To maintain proper pressure while punching operation to avoid wear and tear and to have a proper blanking action.

b) For achieving Delamination process:

- To design a web aligner in order to avoid slippage of the scrap sheet.
- To stabilize the temperature of roller using PID controller.
- Finding the optimum speed to get the proper output and efficiency.

III. PROPOSED METHOLOGY

3.1 For blanking of complex seals

The laminated sheets are pulled into the rotary die with help of feed rollers. The sheet then passes through the upper rotary die and lower anvil cylinder which results into the blanking operation. The upper rotary die is controlled by a pneumatic pressure regulator which decides the depth of cut on the laminated sheet. The die is fixed on the upper roller with the help of a magnetic mechanism. During the operation, the blades on the upper die are pressed on the lower anvil cylinder to cut the sheet into a desirable shape. The blanked seals are collected in a carriage below the rotary die cutter.

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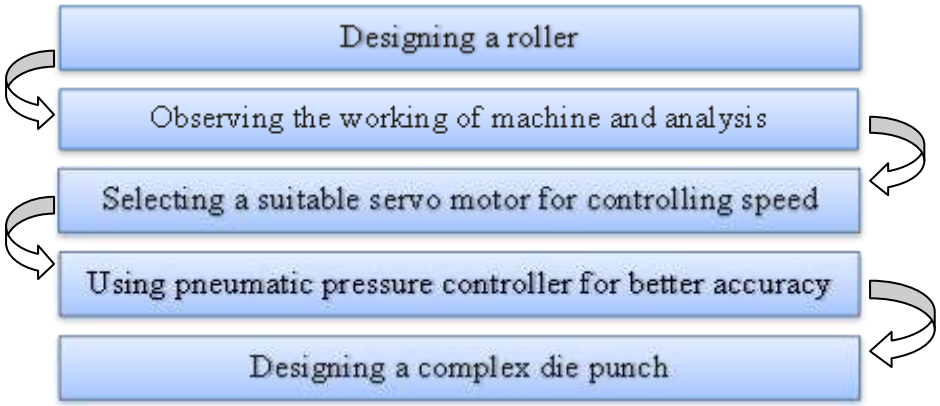

FIGURE 1: Flowchart for blanking of complex seals

3.2 For Delamination Process

The scrap generated from the blanking process is placed onto a feed roller. The sheet then passes through a frame of the web aligner which makes sure that the sheet doesn't slip from the path. The web aligner works with the help of a sensor which detects the slip in the sheet alignment and then signals the hydraulic system to pass the fluid into the hydraulic piston fixed onto the frame which adjusts the sheet alignment. The sheet then passes through two rollers. One is a heating roller which uses resistive heating mechanism but inductive heating can also be used. The other roller is a support roller. As the sheet passes through the rollers, the wax binding the aluminium foil and board melts which results into the separation of the foil and the board. The board and foil are collected on two different rollers respectively.

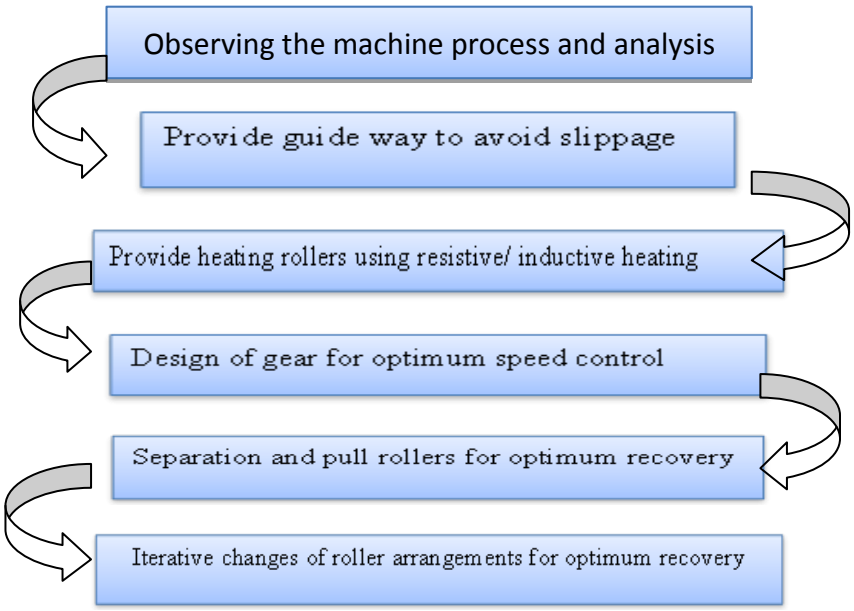

FIGURE 2: Flow chart for Delamination Process

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IV. CONCLUSION

This project will help Maauli Associates in production of complex seals which was not possible with the conventional machines. Also with the improvement of delamination process reduce and recycle their scrap which was not possible before due to the inefficiency of that machine and helps them to attract more customers and grow their business. This also helps in saving their money as inventory carrying cost and waste handling cost decreases.

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