

Design and manufacturing of semi-automatic PVC sealing machine

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Abstract - To satisfy requirements for productivity, versatility and flexibility, the vertical form seal machine was specified and developed to provide pouch packaging rates 9 pouches per minute and 500 pouches per hour. The method uses motor, pulley, VFD and sensors. Cycle (production) rates, quality of packages and control of product slush were improved.

This comes with type temperature controller so as to ensure accurate control of sealer temperature. Some of the other unique features of these semi-automatic machines include belt pulling system for pouches and sensors for providing an enhanced functional speed and accuracy.

Key Words: PVC, Sensor, Design, Productivity, Semi-automatic

1. INTRODUCTION

The vertical PVC sealing machine is a type of automated assembly line product packaging system, commonly used in the packaging industries for FIRST AID kit, food packaging and a wide variety of products. The machine constructs first aid kit out of flat roll of plastic film. Several other machines like vertical form fill sealing machine can be used for both solids and liquids packaging system. This machine is available in 3 forms such as manually operated, semi-automatic, & fully automatic forms. This project deals with modification of manually operated PVC sealing machine to semi-automatic PVC sealing machine with low capital cost than original semi-automatic PVC sealing machines available in market. And it also serves the human mankind.

VFD :- This is also termed as variable speed drive used in electro -mechanical systems to control ac motor speed and torque by varying motor input frequency and voltage. VFD is used for adjusting speed as per required by varying the frequency. The A.C. Electric motor used in VFD system is usually a three phase induction motor. Some types of single phase motor can be used, but 3-phase motors are usually preferred. This 3 -phase induction motors are suitable for most purposes and are generally the most economical motor choice.

PROXIMITY SENSORS:

To control the motion of pulley, on- off switch can also be used. But which becomes quiet difficult to manage and there

may be possibility of damage. So to avoid this drawback, sensors are used. It is able to detect the presence of nearby objects without any physical contact.

Range = 2 to 20mm.Sensing distance = M8 (8mm).

MOTOR

We have used ac induction motor rather than Stepper motor ,ac servo motor and dc motors as their drives are quiet costly. Specification:-1) HP =0.21 KW 2) RPM =1350 3) VOLT=380 V

2. WORKING PRINCIPLE

There are two shafts inside the vertical sealing machine which are mutually perpendicular to each other. As shown in the fig, when the operator press the pedal the vertical shaft which is connected to the pedal moves in the upward direction and which further allows the horizontal shaft and the die to move in the downward direction leaving the impression on the PVC sheet. When the operator releases the paddle, the spring attached to the vertical shaft is used to bring paddle in the original position.

For the manufacturing of pulley, connecting rod, bracket and supports material used is mild steel. As it can withstand the maximum force and it is easily available with low cost.[2]



Fig -1: Before Modification

The machine was manually operated .Firstly, heating of the die is done by supplying the current so that when the paddle is pressed the die gives the proper impression on PVC sheets. That is the operator with the help of his own self weight used to press the paddle with maximum body force so that

the die moves in the downward direction and seal the pouches. About 350 pouches were manufactured per hour. The objective of this project was to install a motor and pulley system to overcome the issues of the vertical PVC sealing machine to eliminate the efforts of human. With foot switch, the operator would be able to actuate the machine. With the help of this switch without giving much efforts to operator, we can increase in productivity within less time.

To develop this system semi-automatic is used followed by motor, pulley, connecting rod, sensors of proximity type and variable frequency drive (VFD).

Motor is attached with pulley and connecting rod. This connecting rod is connected to paddle with support arrangements. There are two proximity sensors placed at 180 degree to each other. Metal sheet is attached to one end of pulley. When pulley rotates from 0 to 180 degree, first sensor will sense the metal sheet attached to pulley and the paddle with required force moves in downward direction and reverse that is from 180 to 0 the second sensor will sense the metal sheet and which will move the paddle in upward direction. In this way this machine is operated and thus we get precise and accurate product with less human efforts.



Fig -2: After Modification

3. DESIGN

3.1 Designing of a Pulley

Outer diameter = 220mm
Required stroke is 180mm
Inner diameter = 180mm

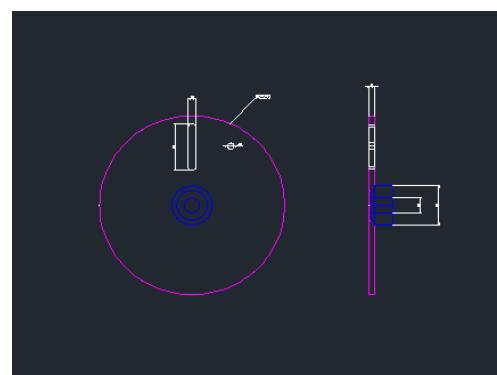


Fig -3: Pulley

3.2 Connecting Rod:

Total Length = 250mm, Required length = 180 mm
horizontal = 18*25*180, vertical = 18*25*220

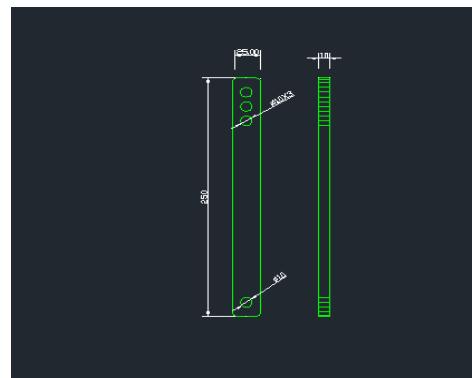


Fig -4: Connecting Rod

3.3 BRACKET:

Height = 75mm
Width = 250mm
Length = 520mm

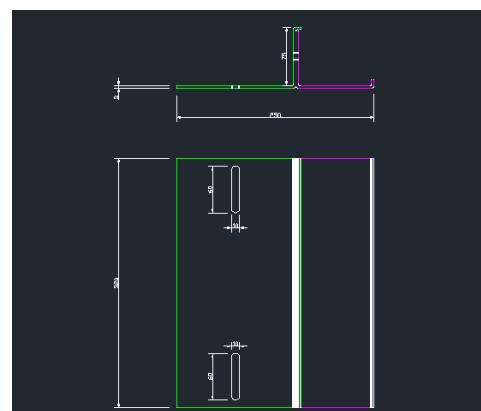


Fig -5: Bracket

4. CALCULATIONS:

4.1 Before Modification:

$$\begin{aligned}\text{Torque} &= \text{weight}^* \text{perpendicular distance} \\ &= 25^* 9.81^* 0.760 \\ &= 186.39 \text{Nm}\end{aligned}$$

4.2 After Modification:

$$\begin{aligned}\text{Power} &= 2 \pi NT / 60,000 \\ 0.25 &= 2 \pi * 45^* T / 60,000 \\ \text{Torque} &= 280 \text{ Nm}\end{aligned}$$

From above calculations torque of the machine after modification is greater than torque of the machine before modification, hence the design is safe.

5. CONCLUSIONS

Our semi-automatic system with foot switch which has been implemented are in running condition and the results are approximately matching with the design value.

We achieved negligible force to operate on foot switch and less time for production according to our design, and by using this modification we got best productivity results and which also reduced the labour efforts.

Following table gives the detail information of machine before and after modification,

Table -1: Information of machine before and after modification

| Sr .n o | Parameters | Before Modifica tion | After Modifica tion | Profit/L oss |
|---------|------------------------------|----------------------|---------------------|----------------|
| 1 | Force | 25 kg | 3 kg | 85% P |
| 2 | Production/h our | 350 pouches | 500 pouches | 42% P |
| 3 | Efficiency | Less | More | P |
| 4 | Energy consumption/ hour | 1.5 | 1.588 | L(Negligible) |
| 5 | Energy consumption rate/hour | Rs.7.5 | Rs.7.94 | L (Negligible) |

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