DESIGN & FABRICATION OF PNEUMATICALLY OPERATED PLASTIC INJECTION MOLDING MACHINE.

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1. Abstract

Plastic is used in various industries, including automotive, packaging, and medical. Plastic is used for its ease of manufacturing, handling, and dependability. Plastic goods manufacturers strive to produce high-quality items on a big scale and at a lower cost. Hydraulic machines provide a solution but are prohibitively expensive for small and medium-sized enterprises. This paper focuses on designing and manufacturing a pneumatic injection plastic molding machine. The manually operated machine is turned into a pneumatically operated machine through correct design procedures.

Keywords: Prototype, Injection Molding, Design, Plastic

2. Introduction

Pneumatically operated plastic injection molding machines use compressed air for molding operations. It is less expensive than hydraulic machines and more efficient than manual machines. Effectively addresses issues faced by small and medium-sized industries. Plastic injection machines operate with two pneumatic cylinders. One injection plastic and another for automatic die opening. The finished product is hot to the touch. The automatic die-opening mechanism is required. Advantages of this machine include improved production, smaller space requirements, reduced risk of oil leakage and fire, and lower cost compared to hydraulic machines. Manual machines have issues with automatic product removal. The pneumatic machine utilizes a pneumatic cylinder to address this issue. Injection molding has proven to be a difficult procedure for many firms and researchers in terms of producing goods that match standards while being economical. Its intricacy and the vast number of process parameter changes required during real-time manufacturing necessitate a significant amount of work to keep the process under control. Furthermore, complexity and parameter manipulation can lead to major quality issues and increased manufacturing costs. One of the primary goals of injection molding is to increase the quality of molded products, in addition to reducing cycle time and production costs. Solving quality issues has a direct impact on injection molding firms' predicted profits. For many manufacturing processes, reaching needed specifications entails maintaining quality control. Injection molding quality features are divided into three categories: mechanical properties, dimensions or quantitative parameters, and attributes. In the development of an injection molding process, DOE can be used to identify machine process factors that have a substantial impact on the process output. The easiest way to set up an injection-molding machine is to rely on the experience of the machine set-up operator or specialist or to use the trial and error method. This trial-and-error method is unacceptable since it is inefficient and expensive. Common injection molding flaws include voids, surface imperfections, short-shot, flash, jetting, flow marks, weld lines, burns, and warpages. Defects in the injection molding process are typically caused by a variety of factors, including the plastic resin's preprocessing treatment before to the injection molding process, the selection of the injection molding machine, and the setting of injection molding process parameter

3. Problem Statement

The problem statement of the Work "Design & Fabrication of Injection Molding Machine for Small Scale Applications" is that existing injection molding machines are typically expensive and too large for small-scale manufacturing operations a result, entrepreneurs and small businesses may find it challenging to access these technology, hindering their ability to produce high-quality plastic products.

We aimed to address this problem by designing and fabricating an injection molding machine that is affordable, compact, and easy to use.

The goal was to create a practical solution for small-scale plastic manufacturing that could help businesses overcome the barriers posed by the high cost and complexity of existing injection molding machines.

4.Objectives

The main objective of this project is to overcome the traditional method,

To increase the efficiency.

To reduce the cycle time of the existing vertical injection molding machine.

To fulfill the needs of the small-scale plastic industry.

To provide a cost-effective and optimized injection molding machine.

5.Methodology

- Analysis of topic
- 2D design of model
- Material selection
- 3D design of model
- Analysis
- Fabrication
- Testing

6. CALCULATION

Pneumatic cylinder

Design of Fatigue Testing Machine

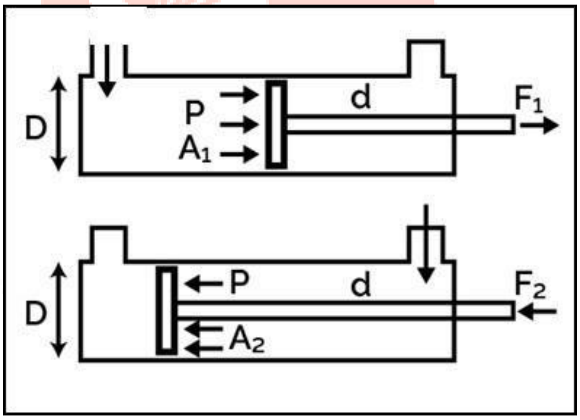
1. Inlet Pressure (P) = 2 Bar
2. The material selected for the body is YST 310 steel grade square pipe, where,

- Ultimate yield strength (S_{ult}) = 310 MPa
- Factor of Safety (FOS) = 1
- Dimension of Square Hallow Pipe = 25×25×2=1250

Total weight act on body approximately 5 kg, mass (W) =5 × 9.81 =49.05 N

Fig 4.1 Double Acting Actuator

Pneumatic Cylinder



Nomenclature

1. Full Bore Diameter (D) = 25 mm = 0.025 m
2. Piston Rod Diameter (d) = 10 mm = 0.010 m
3. Force Exerted while Outward Stroke = F1
4. Force Exerted while Return Stroke = F2

A. A.Force Exerted by Double Acting Cylinder in Outward Stroke

$$F_1 = \frac{P \times \pi \times (D)2}{4}$$

$$F_1 = (2 \times 10^2) \times \pi \times (0.025)^2/4$$

F_1 = 0.098174 N

B. Force Exerted by Double Acting Cylinder in Return Stroke

$$F_2 = \frac{P \times \pi(D2 - d2)}{4}$$

$$F_2 = \frac{(2 \times 10^2) \times \pi(0.025^2 - 0.010^2)}{4}$$

F_2 = -1.47 N

Pneumatic Cylinder 50 mm × 100 mm

Force exerted was

a) Outward Stroke = F1 = 0.098174 N

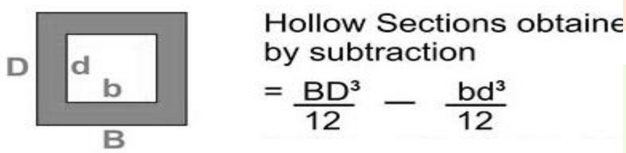
b) Return Stroke = F2 = -1.47 N

FRAME

Load on frame considered P = 5 kg =49.05N

y = D/2 = 25/2 = 12.5mm

D = 25 mm B = 25 mm t= 2mm thickness



Length of frame is 600 mm

Moment of inertia in x direction

I = 16345.34 mm^4

$Mb = \frac{WL}{4} = \frac{49.05 \times 600}{4} = 7425$ N-mm

Bending stress of pipe

$$\frac{Mb}{I} = \frac{\sigma b}{y}$$

$\sigma b = \frac{7425 \times 12.5}{16345.34} = 5.67$ N/mm^2

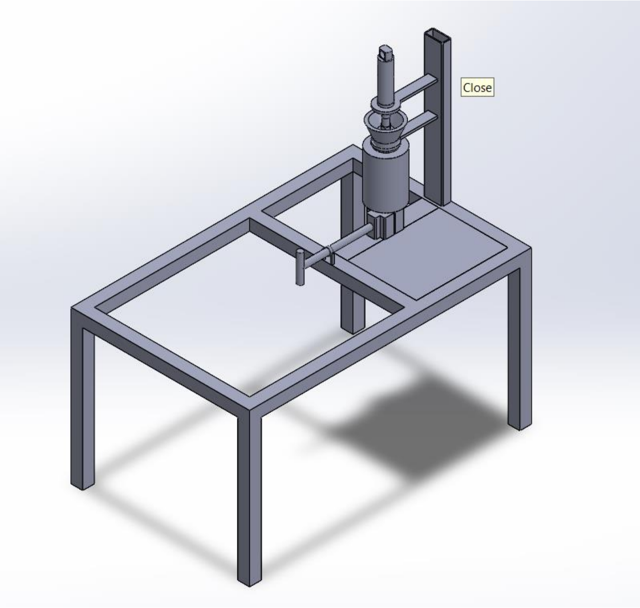
Theoretical bending stress

$\sigma b(th) = \frac{Syt}{f.s} = \frac{310}{1} = 310$ N/mm^2

$\sigma b < \sigma b(th)$

Hence design is safe.

3D Solid Model



6. Conclusion

A mini injection molding machine for Plastic Processing was designed and fabricated which melts and injects (pressurizes) molting materials into mold cavities with ease.

This machine is inexpensive and can be used as learning equipment in school or laboratories and also could be used in the production industry for producing small-size plastic products.

The components design of the machine was properly undertaken and fabrication followed by assembling of the parts. The machine was tested with polypropylene(pp).

The Problems in the operation of the machine were analyzed and corrected.

7. REFERENCES

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