# Design and Fabrication of Injection Moulding Machine

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***Abstract*—Due to lack of processing machines, there is a necessity of such machine which will produce simple as well as complex shaped products with greater efficiency and less efforts. Overall this paper describes design, fabrication and assembling of Injection Moulding Machine. In Injection Moulding, polymer is heated to a highly plastic state and forced to flow under high pressure into a mould cavity, where it solidifies. The process produces discrete components that are always net shape. Complex and intricate shapes are possible to produce, however the challenge is to design mould so that the part can be ejected successfully. Process is economical in large production as the cost of mould is very high. Components and features of injection moulding machine are explained in this paper. Entrepreneurs and businessman can start their business with less investment.**

***Index Terms*— Polymer, Mould, Composites, Granules, Extrusion, Dissertation, Fusion, etc.**

## I. INTRODUCTION (HEADING 1)

Main purpose of this paper is to understand the design and fabrication of Injection Moulding Machine. Design and the mechanism is as kept simple as possible. The concept of the project is such that the knowledge of designing, mechanism and moulding are increased.

This project consists of designing and development of a machine to produce complex cavities with such ease so that the manufacturers can achieve more profit. This project can be directly applied for commercial purposes to produce number of identical machines as a production equipment.

This project includes the process of designing and fabrication of different parts of this moulding machine considering operating temperature, economical and ergonomic factor for manufacturers to use. Main purpose of this project is to generate new technology of Injection Moulding that would last longer, reduce human efforts and make things easier than before. After the design and fabrication, it was transformed to its real product which made the objectives accomplished.

## II. PROBLEM FORMULATION

We are going to design and fabricate such machine that will eliminate most of the problems which were faced such as more cavity cooling time, need of cooling system and human efforts. Productivity increased, efforts are reduced and hence manufacturers earns more profit.

Concept and Objective of the machine is explained below

### a. Concept

By introducing a low cost machine was to overcome various limitations with the current traditional method. The concept of the work is,

(1) Observe the previous method and to identify the drawbacks.
(2) To identify various process variables.
(3) Investigate all areas of automating the technology.
(4) Produce a specification for a low cost system.

### b. Objective

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

(1) To increase the efficiency.
(2) To reduce the cycle time of the existing vertical injection moulding machine.
(3) To fulfill the need of small scale plastic industry.
(4) To provide cost effective and optimized injection moulding machine.

## III. WORKING PRINCIPLE

The main requirement from the machine is that the mould should be flexible. In the most of vertical type injection moulding machine the mould is to be removed after injection of plastic to cool it and for ejection. In this type of machine, pneumatic systems are provided in which upper cylinder operates the plunger for injecting the molten material into mould cavity & the lower cylinder is used to open & close the mould. Granules are poured in the heating barrel through the hopper on it, as granules are melted in heating barrel plunger gets operated by the upper cylinder & molten material is injected into mould cavity. After this, the molten material

gets solidified. Then lower cylinder is operated to open the moulded part is ejected by means of ejector pins. As all the operations are carried out automatically cyclic time reduces, it results in improving the productivity of the machine. In this way the "INJECTION MOULDING MACHINE" works.

## IV. SPECIFICATIONS OF THE MACHINE

### (1) Design of Hydraulic cylinder

(1) The stroke length of cylinder = 264 mm
(2) The rod diameter of the cylinder = 38 mm

### (2) Design of Pneumatic cylinder

(1) Cylinder Pressure, $P_c$ = 10 bar
(2) The stroke length of cylinder, $L_s$ = 150 mm
(3) The rod diameter of the cylinder, $D_r$ = 12 mm

### (3) Design of Allen Screw

(1) Outer Screw Diameter, $D_s$ = 8 mm
(2) Diameter of head, $D_h$ = 13 mm
(3) Height of head, $H_h$ = 8 mm
(4) Key size = 6

### (4) Design of Mould

(1) Number of cooling lines = 3
(2) Temperature of molten plastic, $T_{melt}$ = 120° C
(3) Temperature of coolant (water), $T_{coolant}$ = 25° C
(4) Specified ejection temperature, $T_{eject}$ = 90° C
(5) Mass of moulded component = 3 grams

### (5) Design of Cooling Channel

(1) Max. Diameter of cooling channel, $D_{max}$ = 8 mm
(2) Min. Diameter of cooling channel, $D_{min}$ = 3 mm
(3) Total length of cooling line = 170 mm

### (6) Cooling Parameters

(1) Cooling time for component, $T_{cooling}$ = 12.55 seconds
(2) Heat transfer rate, $Q_{cooling}$ = 1.649 kW
(3) Heat transfer rate per cooling line, $Q_{line}$ = 5496.6 W
(4) Volumetric flow rate of coolant, $V_{coolant}$ = 0.0013 $m^3$/sec.

## V. COMPONENTS AND ASSEMBLY

After completion of design 3D model is created of a semi atomize machine, then regarding development done on moulding machine. Parameters are selected according to objectives. Main mottos of this project were to develop the first prototype of any easy use, low priced and test its performance. Design musts be easy to maintain and should not require highly skilled worker or operator, which is hard to be found in rural and urban areas. Fabrication process should be simple and based on locally available techniques in rural areas. Important components of the Injection Moulding Machine:-

(1) Structural Frame.
(2) Hydraulic cylinder.
(3) Pneumatic cylinder.
(4) Barrel.
(5) Heater.
(6) Toggle switch.
(7) Allen screw.

The assembly of various component of "Injection Moulding Machine" is done as follows:
(1) The Hydraulic and Pneumatic cylinders are fitted on Rectangular frame.
(2) Upper half of the Mould is fitted to the Pneumatic cylinder.
(3) Other part of the mould is connected to Hydraulic cylinder.

(4) Barrel and Heater is fixed in between both parts of the moulds and Assembly is done.

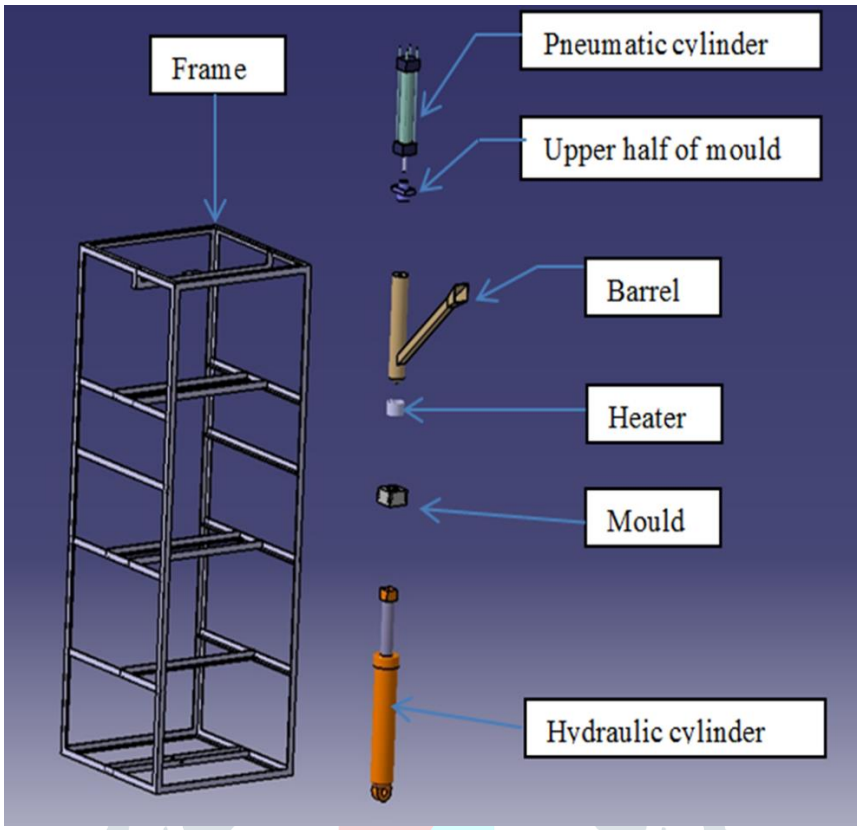


Fig. 1 Exploded view of the machine

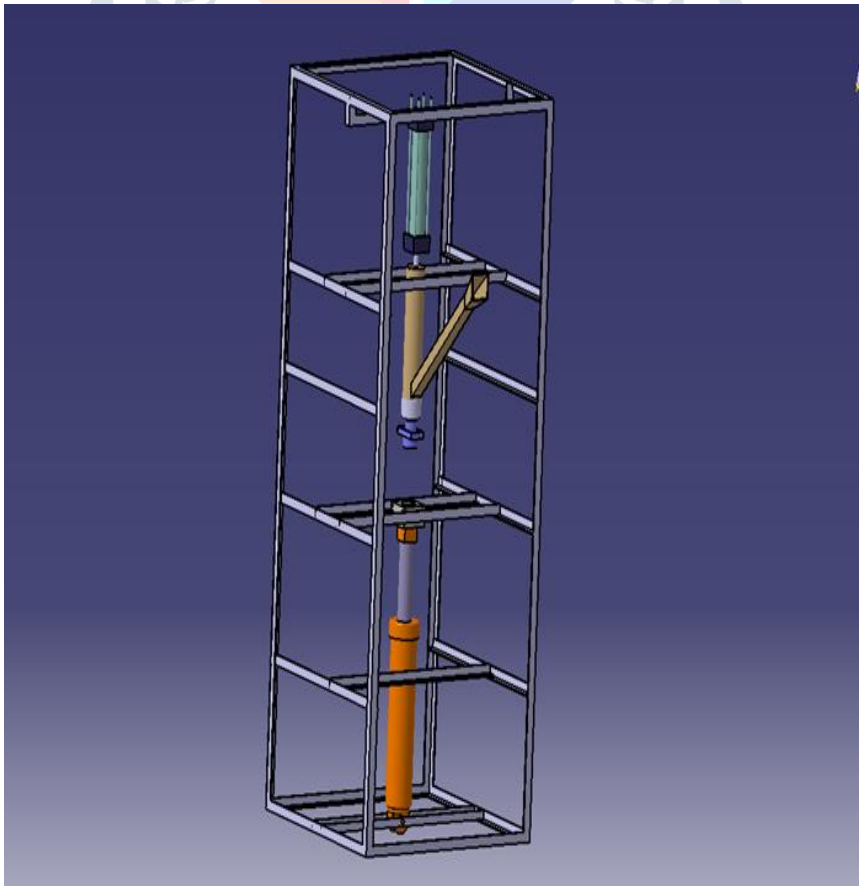

Fig. 2 Final Assembly of Injection Moulding Machine

## VI. TESTING AND ANALYSIS

As load is applied by cylinder on mould from lower side, the mould feels maximum stress when it touches to the upper half.
So, the pressure applied by cylinder = Maximum presser applied by cylinder = 130MPa

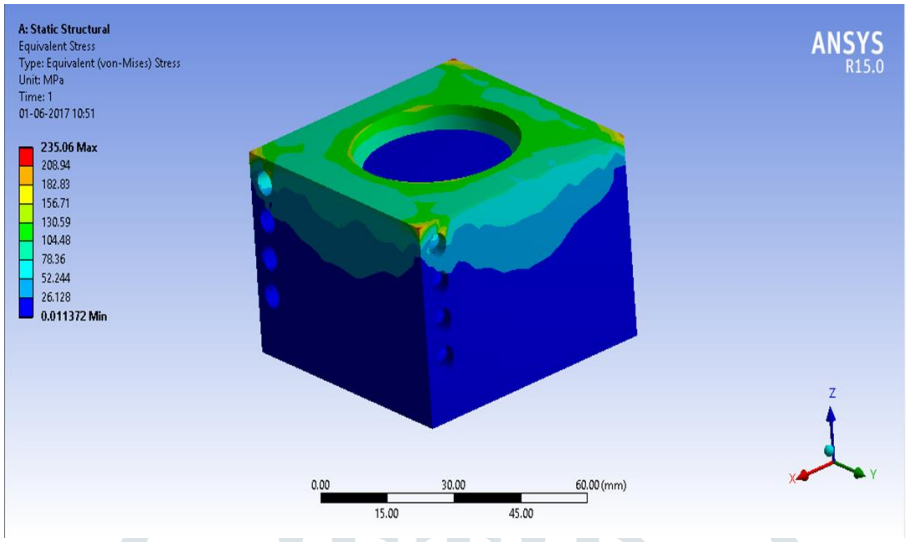


Fig. 3 Equivalent stress on Mould

So applying above static condition with gradual load application, the Finite Element Analysis of lower mould is done in order to seek whether it can sustain the maximum applied pressure or not.
Result shows that the maximum stress at 600 temperature is seems to be 235.06 MPa.
The yield stress, $S_{yt}$ of EN24 = 650 MPa.
So, The Factor of Safety (FOS) = (Yield Stress ($_{Syt}$)/235.06 = 2.76 means design is safe.
Also total deformation observed is 0.01988 which is far lower to get the mould failed.

## VII. RESULTS

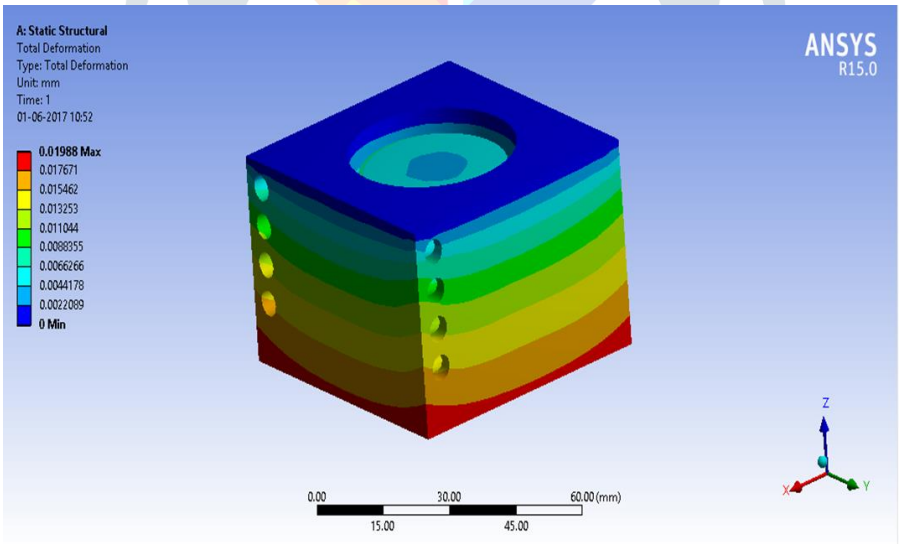


Fig. 4 Deformation of Mould

The result of the analysis done by the ANSYS is that

(1) The maximum stress is on the edges of the mould.
(2) Deformation of the mould will start from the bottom side as the pressure is given from the bottom side by the hydraulic cylinder.
(3) The material used is EN24 which can sustain stress up to 650 MPa.
(4) The hydraulic cylinder can exert pressure up to 130 MPa.

## VIII. CONCLUSION

This work presents the design of a Fluid powered moulding machine. In this project, various parameters such as heating time, cooling time, melting temperature of various plastic materials and pressure required for moulding process are studied. This setup can be used for small scale industries and for mass production by implementing multi cavity mould. The machine can also be used to process various plastic materials having different melting temperatures. The advantage to be derived from the use of this machine far out weights its shortcomings.

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