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STUDY & REVIEW OF DESIGN AND MANUFACTURING OF VERTICAL INJECTION MOULDING MACHINE PROTOTYPE PARTS

M Shoeab Sheikh[1], Dr. Prashant Sharma[2]
[1]Department of Engineering, College of Dairy, Food Science & Technology (MPUAT), Udaipur Rajasthan, India
[2]Principal, SS College of Engineering, Udaipur Rajasthan, India

Abstract: ***The use of plastics is increasing now a days in small to heavy items industries. Injection moulding machine is the one of the most usable machine to manufacture the different plastic items, The main aim of this paper is to study the effect of parameter of design in plastic injection molding machine manufacturing process that influence the quality and cost of the product. During the product development phase functional prototype is required to observe mechanical and functional test on machine. The various parts of Plastic injection moulding machine design using Pro E and that function observed experimentally. The result shown that prototype for vertical moulding machines have similar mechanical characteristics that gives better result and good alternative for plastic items manufacturing as small scale industries.***
Keywords: Prototype, Injection Moulding, Pro-E, Design, Plastics

I. INTRODUCTION

In Pneumatically operated plastic injection moulding machine moulding operation is done with the help of compressed air. It is cheaper than hydraulic machine and more efficient as compared to manual machine. So it solves the problem of small and medium scale industries very well[1]. The process is material is fed into a heated barrel from the hopper, mixed and forced into a mould cavity where it cools and hardens to the configuration of the mould cavity, the features of the desired part such as simple components to complex components. The advantages of injection moulding are high production rate, repeatability high tolerances, low labour cost and minimizes scrap cost but equipment investment and running cost is high[2].

II. DESCRIPTION

The Vertical Injection moulding machine is manufactured by using various components including cylinder, compressor, pressure regulating valve, control valve, nozzle, clamping holder, heater etc. Design of these components give the better accuracy reduces losses of machine failure and less material wastage.3D modeling CAD and Pro E design provides an insight into the nature of processing and consequently offers valuable input towards the design of mould[3]. The compressor provides compressed air to both the cylinders, which causes movement of the plunger. FRL unit is used for filtration, regulation, and lubrication of the compressed. Air filter removes all foreign materials and allow dry, clean air to flow without restriction. Once the compressor air has been properly cleaned, it is necessary to regulate it to the required level of pressure regardless of fluctuations in compressed air main line. Different pneumatic systems work efficiently at different operating pressure. Hence selection of pressure regulator of right range is important for efficient working of pneumatic system.

III. PARTS AND DESIGN OF MACHINE COMPONENTS

The Vertical Pneumatic injection moulding machine consist of various components. Cylinder for compression of air is main components of machine, but the proper selection of design of Barrel, Die, Nozzle, clamping holder is also very important for proper functioning of this small machine.

A. Injection Cylinder

Following points are needed to be considered while selecting a pneumatic cylinder- Cylinder thrust, Air consumption and type of mounting. Injection cylinder gives the require pressure of mould cavity into the barrel.

B. Barrel

The barrel consists of cooling water channel, heater bands, Thermocouple whose function is to note the temperature in various section of barrel. Barrel fed the melted mould resin into the die by air pressure .

Figure .I Barrel and Barrel Design

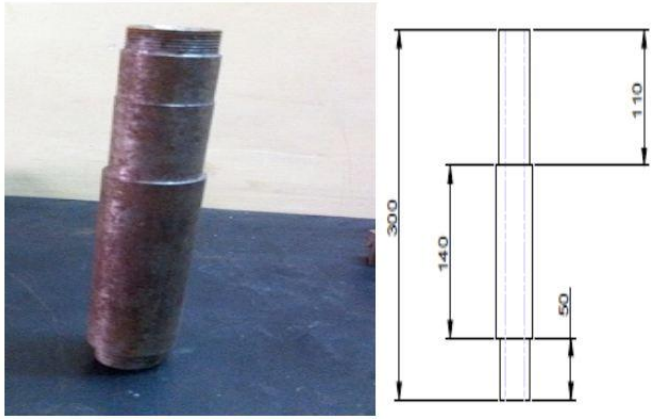


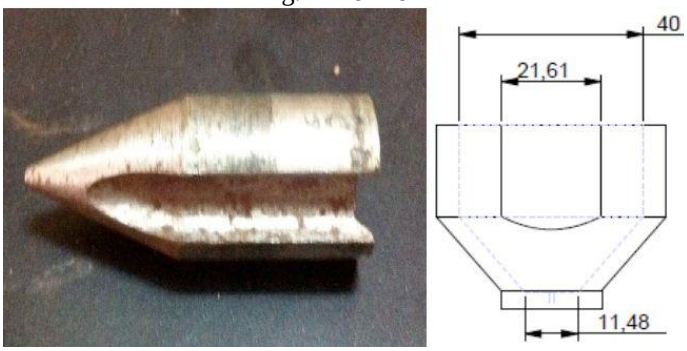
Table 1: Specification of Barrel

Barrel Length	300mm.
Outer Diameter	25 mm.
Inner Diameter	20 mm.

C. Nozzle

Nozzle is located at the end of barrel which provides melt can leave barrel and enter into the mould. Melt can be heated here by friction and conduction from a heater band before entering the relatively cold channels in the mould. Contact with the mould causes heat transfer from the nozzle and in cases where it is excessive it is advisable to withdraw the nozzle from the mould during the screw-back part in the moulding cycle. Otherwise the plastic may freeze-off in the nozzle[3].

Fig. II Nozzle

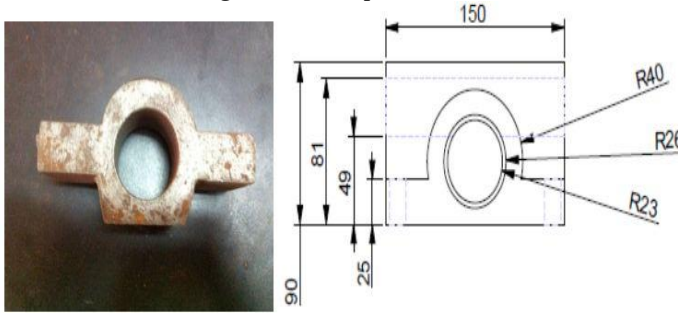


The Plastic resins are moulded at high temperature, the heater with heat capacity can be heated to
about 100-200°C is used, and a band heater is usually used.

D. Clamp Holder

Clamping is used to keep the mould tightly closed under sufficient pressure to let the molten plastic fill in the cavity without leaking during the injection process.

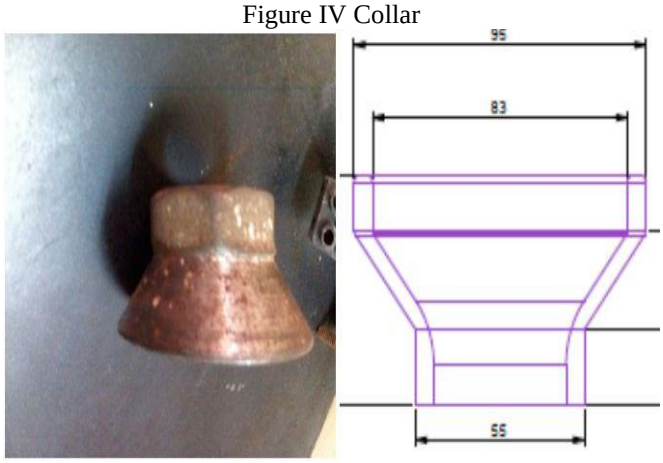
Figure III Clamp Holder



E. Collar or Sprue

Collar is the channel along with the molten plastic first enters the mould through the cylinder
pipes. It delivers the melt from the nozzle to the runner system.

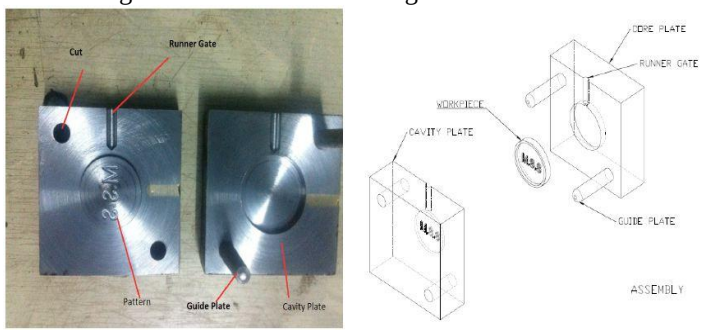
Figure IV Collar



F. Mould Plate

Mould plate or die is usually made in two halves and when closed it forms a cavity similar to casting desired. One half of the die remains stationary is known as “cover die” and the other movable half is called “ejector die”. The die casting method is used for castings of non-ferrous metals of comparatively low fusion temperature and this process is cheaper and quicker than permanent or sand mould casting. Most of the automobile parts are made with this process. This die is made from mild steel using CNC fabrication on it. Core is male portion of the mould forms the internal shape of the moulding. Cavity is the female portion of the mould, gives the moulding its external form of the part[2].

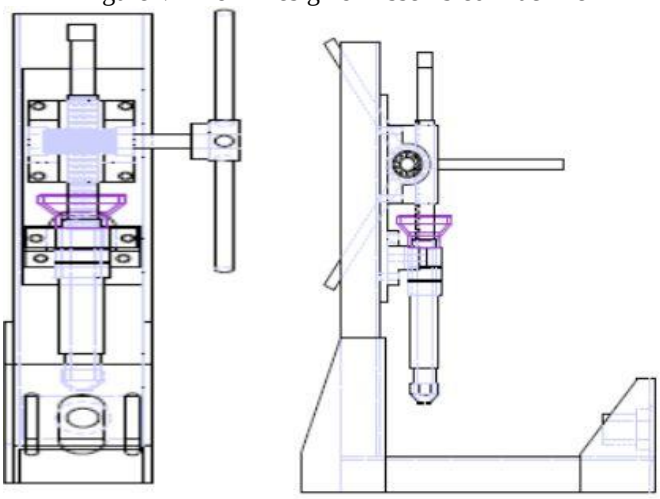
Figure V Die and Pro E Design of Die Plate



IV. WORKING OF PNEUMATIC MOULDING MACHINE

Working of pneumatic machine is as follows: Insert the plastic granules in the barrel from hopper. Heating coil is provided around the barrel which heats the plastic granules. The temperature of this heating coil can be control by dimmer of 1 amp (100o c). The stopper is provided at the bottom of the barrel from its inner side to preventing molten material fall down. The stopper is attached in such a way that if pressure is provided due to the action of plunger molten material gets injected smoothly into the die. Spring is used to provide a clearance between barrel and the die. Compressor is attached to cylinder through 5/2 direction control valve which operate the cylinder.

Figure VI Pro E Design of Assembled Machine



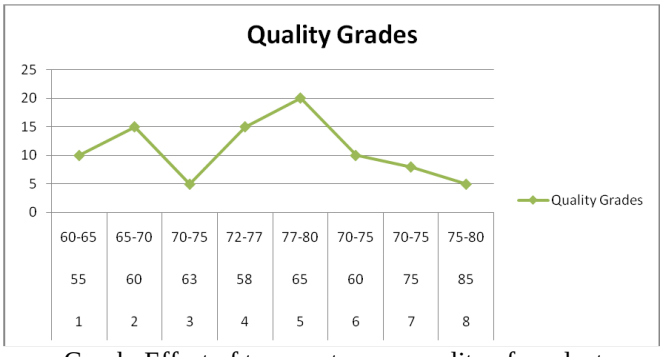
Compressor is attached to cylinder through 5/2 direction control valve which operate the cylinder. The direction control valve is hand lever type of valve. At first stroke compressed air having pressure of 3.2 bar passes into cylinder (100×160) which pushes the plunger downward into barrel and molten material gets injected into the die

Cavity Part	Mould Temperature	Melting Temperature	Temperature at the time of ejection	Quality Grades
1	55	60-65	62	10
2	60	65-70	65	15
3	63	70-75	70	5
4	58	72-77	68	15
5	65	77-80	64	20
6	60	70-75	58	10

Table. II Temperature effect on products

V. EXPERIMENTAL ANALYSIS

The experiments were carried out with different Temperature parameters, for the temperature measurements we used the thermocouples and according to the data presents in table we got the results that shows increasing in Mould & Melting Temperature gives the good Product but it also shows that excess temperature is not suited for mould materials (LDPE) and produced defected in Product output. As per Graph Shows that the best Product output from the cavity part of 5 having mould temperature 65 °C with melting temperature was 77-80 °C.



Graph: Effect of temperature on quality of product

Figure VI Product Quality at various conditions

According to experiments Parameters that affect the Product quality are Temperature, Pressure, Clamping Force, Holding Time.

VI. CONCLUSION

Pneumatic Injection Moulding Process in Small Scale Industries level is becoming greater importance for the manufacturing of polymeric components in small size. This Technology has the characteristics to play a fundamental role in near future in polymeric industries due to :

• Ability of low cost and cycle time Process, useful for mass Production.

• The Increasing capacity of production rate than traditional methods.

• The ability of processing polymers with a wide range of properties according to the functional requested.

Several issues have to be defined from this review, the standardization of this process, best approach to follow according to various part geometry and polymers.

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