

HAND OPERATED PLASTIC INJECTION MOULDING MACHINE

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Abstract— The use of plastic is increased now a days in many industries like automobile, packaging, medical, etc. The reason behind this is that the plastic made things are quite easier to manufacture, handle and reliable to use. So the plastic goods manufacturing industries are striving hard to purchase good quality products injection molten resins into a closed, cooled mould where it solidifies to give the desired products was developed. The machine was designed and constructed to work as a prototype for producing very small plastic components at large scale and cheaper cost.

This work which detailed construction and tests small injection moulding machine that was capable of forming small plastic articles by.

Index Terms— Introduction, Literature review, Aim of objectives, Parameters Working Principles, Applications, calculations,

1 Introduction

1.1 Hand Operated Plastic Injection Moulding Machine

The project comprises of hand operated plastic injection moulding machine. In this main parts are heater, hopper, cylinder, handle, locking block, die clamping adjustment. The arrangement is such that at the top a handle is placed which is connected to pinion arrangement and moves the plunger into cylinder. Plastic is melted into cylinder and then forced into moulding die and then plastic material is obtained. Injection moulding is used to convert different types of plastic materials into useful ones, such as automotive components, household items, pens, medical items, marine components, toys, machine parts and medicine bottles etc.

In this process predetermined quantity of heated and plasticized material is injected into mould under pressure and it solidifies before mould is opened, this solidified product is removed from the mould. Injection moulding process is similar to pressure die-casting. There are different types of machines, which are used to process different types of plastic materials such as Hand operated, cylinder and Ram type, Screw and Cylinder type, hydraulically operated etc. Manually operated machine is used for cottage industries for manufacturing plastic components having weights from 15 to 50 grams.

1.2 PLASTIC AND POLYMERS

We talk about "plastic" as though it's a single material, but there are in fact many different plastics. What they have in common is that they're *plastic*, which means they are soft and easy to turn into many different forms during manufacture. Plastics are (mostly) synthetic (human-made) materials, made from **polymers**, which are long

molecules built around chains of carbon atoms, typically with hydrogen, oxygen, sulphur, and nitrogen filling in the spaces. You can think of a polymer as a big molecule made by repeating a small bit called a **monomer** over and over again; "poly" means many, so "polymer" is simply short for "many monomers." If you think of how a long coal train is made from many trucks coupled together, that's what polymers are like.

The trucks are the monomers and the entire train, made from lots of identical trucks, is the polymer. Where a coal train might have a couple of dozen trucks, a polymer could be built from hundreds or even thousands of monomers. In other words, polymers typically have very large and heavy molecules.

The word, plastic, was derived from the word '*Plastikos*' meaning '*to mould*' in Greek. Fossil fuels have compounds containing hydrogen and carbon (hydrocarbon) which act as building blocks for long polymer molecules. These building blocks are known as monomers, they link together to form long carbon chains called polymers.

1.2.2 TYPES OF PLASTICS:

1. Thermosetting Plastic
2. Thermoplastic

1 Thermosetting Plastic:

A thermosetting plastic is a polymer that irreversibly becomes rigid when heated. Such a material is also known as a thermoset or thermosetting polymer. Initially, the polymer is a liquid or soft solid. Heat provides energy for chemical reactions that increase the cross-linking between polymer chains, curing the plastic. The rate of curing may be increasing in many cases by increasing pressure or by adding a catalyst.

2 Thermoplastic :

A thermoplastic, or thermo softening plastic, is a **plastic polymer material that becomes pliable or moldable at a certain elevated temperature and solidifies upon cooling.** Most thermoplastics have a high molecular weight. The polymer chains associate by intermolecular forces, which weaken rapidly with increased temperature, yielding a viscous liquid

There are four major elements that influence the process. They are:

- The molder
- The material
- The injection machine
- The mold

2. LITERATURE REVIEW

A lot of research is being carried out to understand and identify the effect of plastic injection moulding process parameters on the quality of the plastic product. Till today many optimization techniques were used to control the plastic injection process parameters.

In order to perform this project, literature review has been made from various sources like journal, books, articles and others. This chapter includes all important studies which have been done previously by other research work. It is important to do the literature review before doing the project because we can implement if there are information that related to this project. The most important think before starting the project we must clearly understood about the topic that we want to do.

So by doing the literature review we can gain knowledge to make sure fully understand and can complete the project. A review of the article was performed to identify studies that relevant to the topic. The search to find material that related to the topic is categories as rack and pinion, main frame, cylinder, heater, regulator, moulding die, plunger, and hopper and clamping device.

The effect of melt temperature, injection pressure, packing pressure and cooling time on HDPE material to reduce the shrinkage. In this paper optimal injection moulding condition for minimum shrinkage were determined by the DOE technique of Taguchi methods. The determination of optimal process parameters were based on S/N ratios.

In this paper the authors studied on set of procedures for the optimization of injection moulding process parameters(IMPP), in this study the optical performance and the surface waviness were the two output characteristics of the plastic material. First, the orthogonal experiment was carried out with the Taguchi method, and the results were analyzed by ANOVA to screen out the IMPP having a significant effect on the objectives. Then, the 34 full-factor experiment was conducted on the key IMPP, and the experimental results were used as the training and testing samples

Sanjay N. Lahoti et al.[1], in this research article the authors studied injection molding process parameters for three different thermoplastic materials with at least two varieties in each. And they developed a method to produce defects free parts by controlling the plastic injection moulding process parameters like melt temperature, injection pressure, injection velocity, injection time, packing pressure, packing time, cooling temperature, cooling time. The authors used mould flow software for the research. Sajjan Kumar Lal et al.[2], in this research paper the authors investigated the effects of melting temperature, injection pressure, refilling pressure and cooling time on the shrinkage of LDPE. The main objective of this article was to reduce the shrinkage of the plastic material by optimizing the plastic injection process parameters. In this study, optimal injection moulding conditions for minimum shrinkage during moulding are found by DOE technique (Taguchi method). The authors concluded that the cooling time was the most effective factor for LDPE followed byrefilling pressure and injection pressure was found to be the least effective factor.

3. AIM OF OBJECTIVE

The development in engineering field as led to production and fabrication of different machines. This technology of plastic moulding produces work piece at faster rate, at lower cost has emerged to such a degree that we can raise our present standard of living to this dies.

We decided to use rack and pinion as plunger operating mechanism. For heating purpose we used electric heater because electric heater can withstand high temperature and electric heater are less costly. Clamping the mould is easy as we have used the simple drill vice. Regular has been used to adjust the different temperatures for the different plastics. This project helps us to gain knowledge, experience and skills.

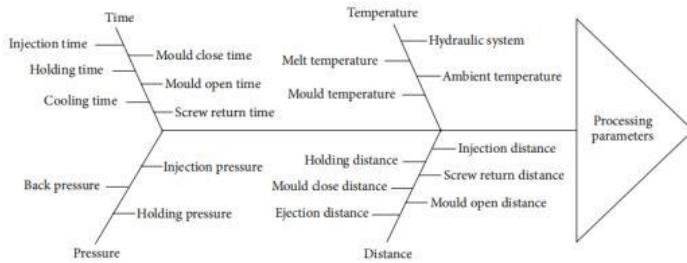
● Main components of the hand operated plastic injection moulding machine:

The injection moulding machine can be broken down into three basic units:

1. the machine base unit,
2. the injection unit,
3. The clamp unit.

4 . PARAMETERS:

There are a number of machine settings that allows the control of all steps of slurry or melt preparation, injection in to a mold cavity and subsequent solidification. Some important parameters of them are like Injection pressure, Injection speed, mold temperature, Processing Temperature; hold pressure, Back pressure, Hydraulic oil temperature, Cooling time, Suck back pressure etc.



- diagram of processing parameters in injection moulding

5. WORKING & PRINCIPLE OF MACHINE

The injection type molding machine works on the principal of heating plastic and make useful product out of it. In this project PID controller is used to set the required temperature to change the state of plastic from solid to semi solid and band heater are used to heat up the hollow tube which contain shredded plastic. First PID controller and band heaters are connected to the power supply through a MCB with the help of wires. The band heaters are connected to the controller via a Solid State Relay. The supply to the heater is controlled. The thermocouple is used to monitor the temperature and continuously



LINE

mechanism
1. The combined
control strategy

the process



6.3 K-TYPE THERMOCOUPLE

Due to its reliability and accuracy the Type K thermocouple is used extensively at temperatures up to 2300°F (1260°C). This type of thermocouple should be protected with a suitable metal or ceramic protection tube, especially in reducing atmospheres.



Fig. 3.3 K-Type Thermocouple.

1.1 PID controller

6.2 BAND HEATERS

Band heaters provide countless solution for cylindrical surface heating applications. Band heaters are most widely used heater because of their versatile design and rugged construction characteristics. Band heaters are designed to clamp to an exterior or interior cylindrical surface. Band heaters often have higher watt densities allowing fast heatup and high operating temperatures. They generally include clamp assemblies making installation easy. Band heaters are used for injection molding barrels and nozzles, extrusion and molding presses, pipe heating, heat treating and autoclaves, food industry and other applications.

7. CALCULATIONS

- Height of rod (L) = 550 mm
- Internal diameter of hollow rod (d) = 26 mm
- Outer diameter of hollow rod (D) = 34 mm
- Diameter of piston rod (DP) = 25 mm
- Height of slot for hopper = 90 mm
- Height of hollow rod below slot = 365 mm
- Total volume of hollow rod = $d \times L$
 $= 26 \times 530$
 $= 13780 \text{ mm}^2$
- Volume of plastic can be stored in hollow rod
 $= 191.13 \times 103 \text{ mm}^3 \text{ OR } 19.11 \text{ cm}^3$
- This volume is neglecting the air gap that may be present between the raw material. The range of raw material that can be accommodated is between 17 cm³ to 18 cm³

8. APPLICATIONS

- These are useful for recycling thermoplastics by suitable product.

- Small objects can be manufactured.
- Mechanical part can be made.
- Injection machine is cheap enough to build at home and easy to build too.
- Simple jobs can be made according to die.
- Using this machine many useful products can be manufactured and can be commercialized to make profit.
- The raw material required is free of cost and easy to find because we are recycling the plastic.

9. ACKNOWLEDGEMENT

It gives us great pleasure to present a project report on **“HAND OPERATED PLASTIC INJECTION MOULDING MACHINE”**. In preparing this project report number of hands helped us directly and indirectly. Therefore it becomes my duty to express my gratitude towards them.

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10. CONCLUSION

- 1 This project helps us to gain knowledge about different plastics and plastic moulding processes.
- 2 We gain the skills and experience of working on different machines like lathe machine, milling machine, CNC lathe, shaper machine, and many others.
- 3 Another important thing we learn from the project is teamwork and time management. It is very necessary to work as a team for completion of project before time.
- 4 As the end of the project we learn many things which will surely help us in future.

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