WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

PLASTIC WASTE INJECTION MOULDING MACHINE

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ABSTRACT –

Well established and flexible is this manufacturing technology in terms of making precision parts in highly efficient and repeatable plastic components. In the injection molding process, the molten plastic material fills the mold cavity at an impressively high pressure such that as it cools, it develops into the needed shape. Now, in any application including all the significant players like automobile and consumer electronic space, for complex geometries accommodated easily but with low usage of the input material; well established are they for injection moldings.

A modern injection molding machine using plastics in the contemporary era is conceptualized to enable modern technology in the mode of computer numerical control, automation, and real-time monitoring to detail. In this manner, there is an improvement in accuracy, energy consumption, and the production cycle time-reduction hence improving the process efficiency and sustainability.

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Performance and sustainability in plastic injection molding machines are now measured by factors such as energy consumption, material efficiency, and environmental impact. Machine design innovation, mold materials, and process optimization have dramatically reduced waste resources while enhancing the quality of products. Of course, more importantly, the use of recycled and biodegradable plastics in injection molding is reducing global concerns over plastic waste and environmental sustainability.

This abstract explains the process of plastic injection molding, detailing the technological development and industrial applications. It further details considerations for sustainability, discussing efficiency in operations, potential environmental impacts, and design improvements for future manufacturing and sustainability challenges.

Keywords: Development, Injection Molding, Plastic Industry, Machine, Quality.

INTRODUCTION :

Injection molding machines are essentially industrial tools used to make raw plastics materials take up the desired form by use of heat and pressure. This commonly is applied in mass production in which a liquid material is injected into a mold in the creation of plastic parts. However, though this technique was mainly used in plastics, it has also been adapted for use with metals, glass, elastomers, and thermosetting polymers known as die-casting. This process starts with feeding raw materials in the form of granules or pellets into a heated barrel. The plastic material is melted, mixed, and injected at high pressure into a mold cavity. Inside the cavity, the material cools and solidifies to take on the precise shape of the mold.

Molds in general are usually made up of metals like steel or aluminum and are extremely accurately made by skilled toolmakers for specific product requirements.
Injection molding is the most common process for manufacturing a wide range of products from small, complex parts to large car body panels. For simpler mold designs, photopolymers—materials that remain stable and unmelted during the processing of certain low-temperature thermoplastics—are often used to add an extra layer of flexibility to the manufacturing process.

An injection molding machine is an important industrial tool that converts raw plastic materials into the desired shape using heat and pressure. Although injection molding primarily uses plastics, it also applies to other materials-such as metals, called die-casting; glass; elastomers; and thermosetting polymers.

In this process, raw materials in the form of granules or pellets are fed into a heated barrel where they melt, mix, and are injected, under very high pressure, into a mold cavity. Once inside the mold, the material cools and solidifies to adopt precisely the geometry of the mold. Professional toolmakers manufacture the molds with high accuracy, usually through the use of steel or aluminum, so that the produced final product accurately meets the designed specifications.

Injection molding is preferred because it can produce small, detailed parts and large structural components. For simpler molds, photopolymers can be used since they are stable and do not melt during the processing of certain low-temperature thermoplastics, giving more flexibility in production.

Step 1:
First, the product to be produced is selected, and a suitable plastic resin that matches the characteristics of the required product, like tensile strength, compressive strength, and stiffness, is chosen.

Step 2:
Prepare the mold, runner and gate, and set up appropriate parameters of the process.

Step 3:
Pour the liquid resin into the mold cavity so that it takes the shape after cooling and solidification at ambient temperature.

Step 4:
Extract the final product out of the mold after it is fully hardened.

Plastic Waste Injection Molding :

Injection molding is a form of manufacture that is involved in the production of parts from thermoplastics and thermosets. This is achieved by melting the material and forcing it through an injection barrel. The barrel itself mixes the material before forcing it into a cavity of the mold. In the mold, the material cools up or hardens into the shape of the mold's cavity.

Molds are prepared and manufactured by professional mold making companies, essentially using precision machined steel or aluminum to achieve accuracy and longer life. It is highly practiced in mass production with parts coming in different sizes, from smaller intricate components up to large car body panels.

WORKING & PRINCIPLE OF MACHINE :

An injection molding machine is an industrial piece of equipment that turns raw plastic materials into specific shapes through the use of heat and pressure. This process is widely utilized for the mass production of plastic components through injecting molten material into a mold.

While injection molding is primarily used in plastics, it can also be applied on other materials such as metals, glass, elastomers, and thermosetting polymers. In metals, the process is referred to as die-casting.

The process begins with feeding raw material, in most cases in granules or pellets, into a heated barrel. Inside the barrel, the material melts and is mixed up; it is then injected at a high pressure into a mold cavity. Within the cavity, the molten material cools down and solidifies, thus attaining the precise shape of the mold.

Molds are typically made of steel or aluminum and are designed and manufactured by a toolmaker.
Their strength and accuracy enable the large quantities with uniformity and quality.

CONSTRUCTIONAL PARTS OF MACHINE :

1.1 RHEOSTAT

The most familiar device used in varying the resistance in a circuit is a rheostat. 'Rheostat' is a term invented by Sir Charles Wheatstone about 1845, from Greek roots meaning 'setter,' or more accurately, 'regulating device.' It has two terminals and is also a variable resistor. Since the early twentieth century, however, the term rheostat has fallen into relative disuse, and a potentiometer is spoken of in most instances. In the case of low-power applications, less

than 1 watt, a three-terminal potentiometer is used where one of the terminals is either left open-circuited or else is connected to the wiper. For higher power—more than 1 watt—the resistance wire is wound on a semicircular insulator with the wiper sliding across the wire turns to form a rheostat.

Fig. 3.1 RHEOSTAT

1.2 BAND HEATERS

Drum heaters are used to make it easier to fill, pump, or bottle respective liquids by heating them that decreases the viscosity of liquids and gels. It helps in preventing liquids from freezing inside a drum. Some liquids are chocolate, tar, grease, varnish, gelatine, or resin for bottling applications. There are drum heaters suitable for drums from 20 up to 220 litres.

Fig. 3.2 Band heaters

1.3 Solid-State Relay (SSR)

A solid-state relay is an electronic switch that turns ON or OFF based upon small external voltages applied to its control terminals. It usually consists of three major parts or components:

1.Sensor: Detects the control signal.
2,Solid-state switching component: It controls the power supply to the load circuit.
3.Coupling mechanism: It lets the switch operate without mechanical parts.SSRs will switch power to the load, so this is exactly equivalent to electromechanical relays. Unlike their electromechanical counterparts, though, SSRs have no moving parts and hence are much harder-wearing and reliable.

FIG. 3.4 solid state relay.

Machine Assembly Procedure :

In our project, we will begin with the assembling of the plastic recycling machine. The steps for the assembly procedure are as follows:
Collection of all tools needed for plastic machine building
1 The frames
2 PID control, SSRs, and an MCB.
3 Band heaters,
4 K-type thermometers

FRAME

Since it's a mechanical model, an extensive and solid base was needed. Therefore, The triangular base was fabricated. A square frame was made from two square pipes welded perpendicularly at one corner of the triangular base.

Fig. 4.1 Framework

The frame is constructed using mild

Steel is employed for strength and rigidity; the welded framework supports the hollow rod and piston. A square pipe, akin to that used in the frame, acts as a lever screwed onto the top of the piston, allowing for its reciprocating vertical motion. Bolts and nuts are located at major moving joints for smooth movement in all directions.

BAND-HEATERS

Four heaters are utilized on the outside of the hollow rod, where the plastic is melted. These heaters are in parallel and connected through an SSR to a PID controller for control.
Usually, band heaters have high watt densities that enable them to heat up fast and, at the same time, operate at elevated temperatures. Clamp assemblies are often mounted to make easy installation possible. The nuts and bolts on the band heaters we used made removal and reattachment quite easy. They are strongly used when heating injection molding barrels and nozzles.

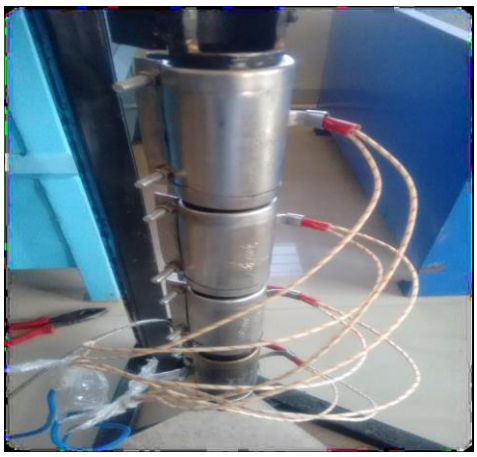

Fig. 4.2 Assembly of Band Heater

PID CONROLLER, SSR AND MCB

After assembling the frame, we added the electronics and mounted the entire circuit on plywood because it is non-conductive, so that current will not leak, which would significantly minimize the electrical shocks.

Fig. 4.3 Assembly of PID controller

4.4 K-Type Thermometer

There normally is one thermometer end connected on the ports to the PID controllers; in addition, it will be attached with the band heaters for measuring purposes. The control and maintenance at the desired temperatures will be ensured by the control of the SSD with the temperatures displayed by the PID controller simultaneously.

A strip of sheet metal is also provided on the outside of last band heater such that the thermocouple gets stuck to hollow tube. It should be pressed straight onto the tube for increased sensitivity and response.

Fig. 4.4 Plastic Injection Molding Machine

Specifications:

- Height of Rod (L): 550 mm
- Internal Diameter of Hollow Rod (d): 26 mm
- Hollow Rod Outer Diameter D 34 mm
- DP= 25 mm (Piston Rod Diameter)
- Height of Slot for Hopper: 90 mm

FIRST TRIAL :

We began by casting using polypropylene (PP) as feedstock, this feedstock having been obtained as scrap from abandoned automobile oil tin cans and shreds manually carried out. Processing temperature was bellow 200°C, in such a way that we determined wood as an ideal die-material due to facilitation of facile machining and plastic shaping into our desired cavity, The following shows the output after our first trail

APPLICATIONS :

- Your list is quite clear and structured. Here is a slightly rearranged version for better flow:
- Helpful in recycling thermoplastics into workable products.
- Capable of producing small, delicate products.
- Can produce mechanical components.
- The injection machine is inexpensive and easy to construct at home.
- Based on the design of the die, simple products can be produced.
- Machine can commercialized for profit.
- It is absolutely free raw material and easily available because it is sourced from recycled plastic.

CONCLUSION :

- We may therefore conclude that our project is feasible for construction at a minimal cost because the plastic injection machine is inexpensive, and any broken part is easily replaced.
  The machine requires no special skills to operate, other than an understanding of the electronic connections. The electronic circuit is simple to grasp, and anyone familiar with the provided circuit diagram should have little trouble assembling the electronics.
- The parts we fabricated only require general fabrication skills, not requiring any specific machines.
- All the equipment required can be sourced from a basic workshop.
- As it is hand operated, the machine does not have a prime.
  In a band heater, electrical supply is only needed..

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