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# Vertical Injection Plastic Moulding Machine

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**ABSTRACT:** In today's rapidly advancing industrial landscape, plastic has become increasingly vital. Products made of plastic, both small and large, are widely utilized. We utilize this approach to manufacture Vertical Injection Plastic Moulding Machines, which are more efficient than other machines, reducing production time, improving product quality, and increasing output. Vertical injection plastic moulding machines are designed to produce delicate and intricate plastic parts through the injection moulding process. This abstract outlines the key features, benefits, and applications of these machines. Compared to horizontal machines, vertical machines have a smaller footprint, provide easier mold changes, and utilize gravity to aid in the injection process. These machines are well-suited for creating a diverse range of plastic components due to their flexibility and compatibility with various molds and materials. They are widely used in industries such as automotive, electronics, consumer goods, and medical devices. Vertical injection plastic moulding machines are crucial for industrial applications that demand consistent quality and reliability, as they can produce high-precision products with tight tolerances. In summary, vertical injection plastic moulding machines are exceptionally efficient and versatile for manufacturing complex plastic parts. Their compact size, precision, and adaptability make them essential for various types of production.

**KEYWORDS:** Plastic, injection, moulding, etc

## I. INTRODUCTION

The vertical injection plastic moulding machine operates using a high-pressure hydraulic cylinder, making it more efficient compared to non-automatic machines. This type of machine is an ideal choice for industrial applications due to its compact size and reduced manpower requirements. The process involves melting plastic and injecting the molten material into a die under high pressure, resulting in improved production speed and product quality. This fully automatic process reduces production time and enhances precision, ensuring that even small parts are produced accurately. Additionally, the machine allows for recycling used plastic to create new products. Injection moulding, a common manufacturing technique, involves injecting molten plastic into a mould cavity to form the desired shape, which then cools and hardens. This method is widely used in various industries, including consumer products, automotive, electronics, and medical devices, due to its versatility, efficiency, and cost-effectiveness. The operation begins with designing a mould, typically made of steel or aluminum, with two halves to shape the final product. The mould is mounted on the injection moulding machine, which feeds plastic pellets from a hopper into a heated barrel, where they are melted and injected into the mould cavity.

## II. LITERATURE REVIEW

Paper [1]: This paper explores a screw-type injection plastic moulding machine, using a screw mechanism to press material into the mould. It details the design and manufacture of a bench top injection moulding machine for educational use. The machine features a vertical plunger-type injection system with a clamping mechanism, a 290 cc barrel, and a 60 mm injection plunger, making it suitable for labs. The design process and preliminary tests show that increasing motor speed raises the flow rate while decreasing packing time. At 2500 rpm, the flow rate is 0.42 m/s, and packing time is 15 seconds. In Paper [2] the study examines the impact of design parameters on the plastic injection moulding process, focusing on a machine using a handle piston to press material into the mould. With the growing use of plastics in various industries, injection moulding machines are essential for producing diverse plastic items. The paper emphasizes the importance of design parameters on product quality and cost. Prototypes are tested for mechanical and functional performance using Pro E software. Results show that vertical

moulding machine prototypes have favorable mechanical characteristics, making them viable for small-scale plastic manufacturing. In Paper [3] the paper focuses on using a handle piston to press material into the mould in the injection moulding process. In Paper [4] the study validates and analyzes injection moulding process parameters, identifying key factors that enhance quality and reduce costs in the plastic industry. It examines the effects of weight melt temperature and injection pressure on polypropylene injection moulding. Over time, manufacturers have sought more complex parts and subassemblies. To meet these needs, the paper discusses services like assembly, decorating, reusable packaging, and RFID. By integrating production, design, supply chain management, and logistics, the paper argues that comprehensive solutions can lower costs and increase profitability. In Paper [5] the paper presents a monitoring system design for integrated vertical injection moulding machines. The system includes field-coordinated control, data collection and transmission, and remote monitoring. The proposed scheme covers hardware (Input/Output configuration, hardware configuration, and CAN node design) and software (communication strategy and monitoring interface). Practical application shows the system can enhance production efficiency and reduce maintenance costs.

### III. BLOCK DIAGRAM AND MAIN COMPONENTS

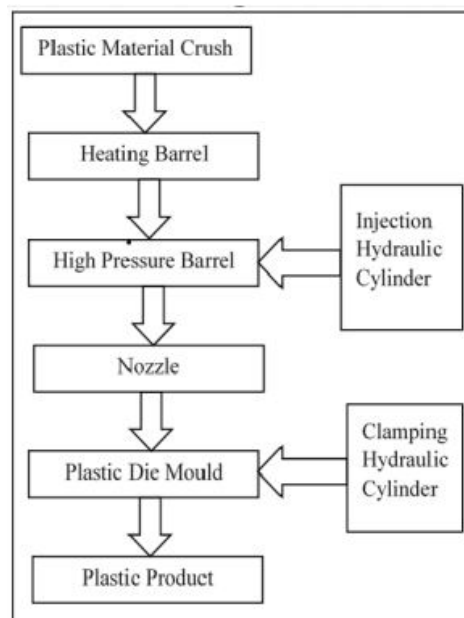


Figure 1: Block diagram.

**MAIN COMPONENTS:** This machine employs the injection moulding method. It includes a heating barrel, a clamping hydraulic cylinder, an injection hydraulic cylinder, a paper plate heating coil, a nozzle, and a plastic die mould.

1. Barrel: The barrel's function is to melt the material. It includes a cooling water channel, heater bands, and a thermocouple to monitor the temperature in different sections. The melted resin is then fed into the die by a hydraulic cylinder. Shown in Figure 2.
2. Clamping hydraulic cylinder: The clamping mechanism of the hydraulic leverage cylinder operates on the principle of leverage, utilizing hydraulic pressure to move the piston rod vertically. This action generates a clamping force to secure or release the workpiece, thereby enhancing work efficiency. Shown in figure 3.



Figure 2: Barrel



Figure 3: Clamping hydraulic cylinder

3. Injection hydraulic cylinder: Hydraulic cylinders are devices that utilize pressurized hydraulic fluid to generate linear motion and force. They find application in various power transfer tasks and can operate as single or double action mechanisms.



Figure 4: Injection hydraulic cylinder

4. Band heater: A coil is a heating element integrated within the heating unit. The heater generates electric current, which is then transferred to the coil. The heating coil converts electrical energy into heat energy. It can either directly immerse in a medium to heat it or radiate heat into an open space.



Figure 5: Band heater



Figure 6: Plastic die mould

5. Plastic die mould - In the plastic die mould, a nozzle is employed to feed the melted plastic material into the die. Positioned at the end of the barrel, the nozzle facilitates the passage of melted material from the barrel into the mould. Shown in figure 6.

#### IV. SELECTION CRITERIA AND CONSIDERATIONS

Ensuring optimal performance and reliability requires careful consideration when selecting a vertical injection plastic moulding machine. The following key factors and criteria are crucial:

1. Machine size and dimensions - It's important to ensure that the machine fits within your production space and can accommodate the size of the molds used.
2. Injection capacity - Evaluate the machine's injection capacity based on the size and complexity of the parts to be manufactured.
3. Clamping force - Select a machine with adequate clamping force to securely hold the mold closed during the injection process.

4. Energy efficiency - Choose a machine with energy-efficient features to reduce operating costs and minimize environmental impact.

## V. OPERATIONS

The plastic resin used in the production process is a critical component of this system. The resin is inserted into the heating barrel where it undergoes melting. Surrounding the heating barrel is a heating chamber equipped with a heating coil, which is regulated by a temperature controller and monitored by a thermocouple sensor. The resin melts within the heating chamber due to the heating coil. The temperature of this coil varies depending on the type of plastic resin used. Once melted within the high-pressure barrel, the molten material is injected into a mold at high pressure using an injection hydraulic cylinder. Next, the melted plastic material is delivered to the mold via a nozzle. The high-pressure melted plastic material is injected into the plastic die mold, shaping it into the desired plastic products. To secure the plastic mold in place, a clamping hydraulic cylinder is utilized. This machine employs the injection molding method for its operations.

## VI. RESULTS

We have considered 10 gm plastic product

Table 1: Results

| Sr no | Title                       | Manual        | Automatic    |
|-------|-----------------------------|---------------|--------------|
| 1     | Quantity of product Per Day | 650 Pieces    | 1000 Pieces  |
| 2     | Time Required For One Cycle | 10-15 sec.    | 8 sec.       |
| 3     | Man Power                   | 100% Required | 50% Required |
| 4     | Energy Consumption          | 3.7 KWH       | 3.1 KWH      |

Final Hardware:



Figure 7: Final Hardware

## VII. ADVANTAGES OF VERTICAL INJECTION PLASTIC MOULDING MACHINE

- 1) Energy-efficient - Automatic vertical machines typically occupy less space and consume less energy compared to manual machines, thereby reducing operating costs.
- 2) Reduced risk of contamination - Vertical machines position the mould above the injection unit, minimizing the potential for debris or foreign particles to contaminate the machine.
- 3) Improved cycle times - Automatic vertical machines often achieve faster cycle times than manual machines, leading to higher production rates and quicker turnaround times.
- 4) Energy-saving - In general, vertical machines are characterized by their smaller footprint and reduced energy consumption.

## VIII. CONCLUSION

In conclusion, vertical plastic injection moulding machines play a vital role in the manufacturing sector for producing a wide range of plastic products. These machines offer advantages such as straightforward operation and efficient production capabilities, making them suitable for diverse industries including electronics, medical devices, and automotive sectors.

To achieve the desired outcome, molten plastic is injected into a mold cavity under high pressure using vertical plastic injection moulding machines. The material then undergoes cooling and solidification. Vertical machine configurations simplify mold access, enhancing setup and operational efficiency.

Overall, vertical plastic injection moulding machines provide a cost-effective and reliable method for manufacturing high-quality plastic components.

## IX. FUTURE SCOPE

### 1. Increased Demand Across Industries:

Vertical injection moulding machines are highly valued in industries such as electronics, automotive, medical, and consumer goods due to their precision, efficiency, and ability to produce complex components. As these industries expand, the demand for high-quality plastic parts rises, thereby boosting the market for vertical injection moulding machines.

### 2. Technological Advancements:

Continuous technological advancements, including automation, IoT integration, and advanced control systems, are enhancing the performance and efficiency of vertical injection moulding machines. These innovations improve precision, reduce cycle times, and lower production costs, making them increasingly attractive to manufacturers.

### 3. Sustainability and Material Innovation:

With a growing emphasis on sustainability, there is a trend towards using biodegradable and recycled materials in plastic moulding. Vertical injection moulding machines are evolving to effectively handle these new materials, supporting environmentally friendly manufacturing processes.

### 4. Customization and Flexibility:

The ability to manufacture customized parts with complex geometries is a significant advantage of vertical injection moulding machines. As industries demand more specialized components, the flexibility offered by these machines becomes increasingly crucial.

### 5. Global Market Expansion:

The global market for injection moulding machines, including vertical types, is expanding, driven by emerging economies and increased industrialization.

#### 6. Expansion in Medical and Healthcare Industries:

The medical and healthcare sectors are experiencing rapid growth, driven by the aging global population and advancements in medical technology. Vertical injection moulding machines play a critical role in producing precision medical components such as syringes, implants, and diagnostic devices, contributing significantly to sectoral growth.

#### 7. Adoption of Electric Machines:

There is a shift towards electric vertical injection moulding machines due to their energy efficiency, precision, and lower environmental impact compared to hydraulic machines. This shift is expected to continue as manufacturers aim to reduce operational costs and improve sustainability.

#### 8. Integration with Automation and Robotics:

The integration of automation and robotics with vertical injection moulding machines enhances productivity, consistency, and safety in manufacturing processes. Automated systems can manage tasks such as part removal, quality inspection, and packaging, reducing human intervention and increasing overall efficiency.

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