Design And Fabrication of Hand Mould Die For Stud Protection Cap

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Abstract- *This study presents the design and optimization of a two-cavity injection mould for LDP24FS040 caps, enhancing efficiency by producing two caps per cycle. Key factors like cavity layout, runner system, and cooling channels were optimized for performance. Compared to single-cavity moulds, this design improves cycle time, material utilization, and cost-effectiveness. Mechanical testing confirms durability and flexibility, while environmental analysis supports LDP24FS040's sustainability. The results demonstrate that two-cavity injection moulding boosts productivity while maintaining high quality, making it ideal for mass production.*

Keywords- Two-cavity injection mould, LDP24FS040, multi-cavity moulding, cycle time optimization, material utilization, mould design, runner system, cooling efficiency, mechanical properties, sustainable manufacturing.

I. INTRODUCTION

This study presents a two-cavity injection mould for LDP24FS040 caps, improving efficiency by producing two caps per cycle. The design optimizes cycle time, material use, and cost-effectiveness while ensuring durability and quality. Key factors like cavity layout, runner system, and cooling efficiency are analyzed to enhance mass production.

This study presents the design and development of a two-cavity injection mould for LDP24FS040 caps, specifically designed to fit the ends of round pipes. The mould enhances production efficiency by manufacturing two caps per cycle, reducing cycle time and material waste. The mould consists of five plates: the three middle plates are made from P20 steel for durability and precision, while the two outer plates are made from mild steel (MS) for structural support. Key design aspects, including cavity layout, runner system, and cooling efficiency, are optimized to ensure high-quality cap production. This research highlights the advantages of multi-cavity injection moulding for mass production and industrial applications.

II. IDENTIFY THE PROBLEM AND REQUIREMENTS

For efficient cap production on round pipe ends, a two-cavity mould is designed to increase output and reduce cycle time. LDP24FS040 is chosen for its flexibility, durability, and chemical resistance. The mould consists of five plates—three P20 steel plates for precision and two MS plates for support. Optimization focuses on faster coolingbetter material flow, and cost-effectiveness to enhance efficiency

To further enhance production efficiency, the mould design incorporates a balanced runner system, ensuring uniform distribution of molten material across both cavities. This prevents defects such as air pockets, uneven filling, and short shots, which can compromise the final product quality. Additionally, the gate placement is optimized to minimize material wastage and improve flow characteristics, resulting in consistent cap formation.

The cooling system is strategically designed with well-placed cooling channels to accelerate heat dissipation, reducing cycle time while maintaining dimensional accuracy. Proper cooling prevents shrinkage issues and warping, ensuring that the caps maintain their intended fit on round pipe ends. The use of high-quality P20 steel in the middle plates enhances the mould's durability, reducing wear over time and minimizing maintenance requirements.

Furthermore, the ejection system is carefully engineered for smooth cap removal without deformation. A precisely calculated ejection force ensures that the moulded parts are released efficiently, preventing surface defects or damage. The integration of an optimized clamping mechanism maintains uniform pressure distribution during the moulding process, ensuring that both cavities operate at peak efficiency.

From a cost perspective, the two-cavitymould significantly improves material utilization, reducing scrap rates and optimizing production costs. The selection of LDP24FS040 not only ensures flexibility and durability but also contributes to the sustainability of the manufacturing

process due to its recyclability. These enhancements collectively make the mould highly effective for mass production while maintaining high product quality and efficiency.

III. STUDIES AND FINDINGS

Studies on multi-cavity moulds confirm that increasing the number of cavities improves production rates while maintaining product consistency. The two-cavity mould design significantly reduces cycle time compared to single-cavity moulds, enhancing overall efficiency. LDP24FS040 has been found to offer excellent flexibility, durability, and chemical resistance, making it ideal for pipe end caps. Its low shrinkage rate ensures dimensional stability in injection moulding. The five-plate mould structure, with three P20 steel plates for precision and two MS plates for support, enhances durability and structural integrity. Additionally, a balanced runner system ensures even material flow, preventing defects such as short shots or warpage, while optimized cooling channels contribute to faster cycle times and reduced energy consumption. The findings also highlight that two-cavity moulds minimize material waste and improve utilization, making production more cost-effective. Furthermore, the recyclability of LDP24FS040 supports sustainable manufacturing practices.

Multi-cavity mould designs are widely adopted in modern manufacturing to enhance productivity while maintaining high product quality. The use of a two-cavity mould in this study demonstrates a significant improvement in production rates, reducing cycle time compared to single-cavity moulds. This approach not only increases efficiency but also optimizes material utilization, making it a cost-effective solution for mass production. The precise control of mould parameters ensures uniform product consistency, minimizing defects such as warpage, shrinkage variations, and incomplete fills.

LDP24FS040, a variant of LDPE, is selected for its excellent flexibility, impact resistance, and chemical stability, making it highly suitable for pipe end caps. Its low shrinkage rate ensures dimensional accuracy during the moulding process, preventing deformations that could affect product performance. Additionally, the material's ability to withstand environmental factors such as moisture, UV exposure, and temperature variations further reinforce its suitability for industrial applications.

The mould's five-plate structure, consisting of three P20 steel plates for precision and durability, and two mild steel (MS) plates for structural support, enhances overall mould longevity. P20 steel provides excellent hardness and wear resistance, reducing the need for frequent maintenance and ensuring consistent production quality over extended use. The inclusion of a balanced runner system plays a crucial role in optimizing material flow, ensuring that both cavities receive equal distribution of molten LDPE, preventing short shots, air entrapment, or excessive pressure variations.

An efficiently designed cooling system further enhances the performance of the injection moulding process. Optimized cooling channels accelerate the heat dissipation process, reducing cycle time and improving overall energy efficiency. Proper cooling ensures uniform solidification of the moulded caps, preventing warping and maintaining tight dimensional tolerances. This improvement leads to faster production rates without compromising product integrity.

Moreover, the sustainability aspect of using LDP24FS040 is a key consideration in modern manufacturing. The material's recyclability supports environmentally friendly production practices, reducing plastic waste and promoting circular economy principles. The ability to reprocess and reuse LDPE materials makes this approach more sustainable, aligning with global efforts to minimize plastic pollution and improve resource efficiency.

Overall, the adoption of a two-cavity mould with an optimized design and material selection not only enhances productivity and cost-efficiency but also ensures consistent product quality and sustainability. The findings reinforce the advantages of multi-cavity injection moulding in industrial applications, making it a preferred choice for large-scale production of high-quality pipe end caps.

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IV. CONCLUSION

The development of a two-cavity injection mould for LDP24FS040 caps has significantly improved production efficiency by reducing cycle time and increasing output. The optimized mould design, featuring a five-plate structure with P20 steel for precision and MS for support, ensures durability and structural integrity. The balanced runner system and enhanced cooling channels contribute to better material flow, defect prevention, and faster cooling. Additionally, LDP24FS040's flexibility, durability, and recyclability make it a suitable material for pipe end caps while supporting sustainable manufacturing practices. Overall, the findings demonstrate that a two-cavity mould enhances productivity,

cost-effectiveness, and quality, making it a viable solution for mass production applications.

V. APPENDIX

A. Mould Specifications

- Type: Two-cavity injection mould
- Material: LDP24FS040
- Structure: Three P20 steel plates (precision), two MS plates (support)

B. LDP24FS040 Properties

- Cycle Time: Reduced vs. single-cavity moulds
- Ejection**:** Smooth cap removal system

C. Testing & Quality Control

- Accurate dimensions, high mechanical strength, smooth surface finish

D. Additional Notes

- Efficiency, cost-effectiveness, and sustainability improvements
- Potential for further automation and surface treatments

VI. TECHNICAL SPESIFICATION

Cap Specifications

Material: LDP24FS040
Shape: Designed to fit the ends of round pipes
Wall Thickness: [2.7mm]
Outer Diameter: [42.14mm]
Durability: High resistance to wear and chemicals

Injection Moulding Parameters

Injection Pressure: [7000psi apx]
Melt Temperature: [105 to 115 degree]
Mould Temperature: [20 to 120 degree]
Cycle Time: Reduced compared to single-cavity moulds
Clamping Force: [Specify value

VII. ACKNOWLEDGMENT

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Fig 1Product

Figure2Mould

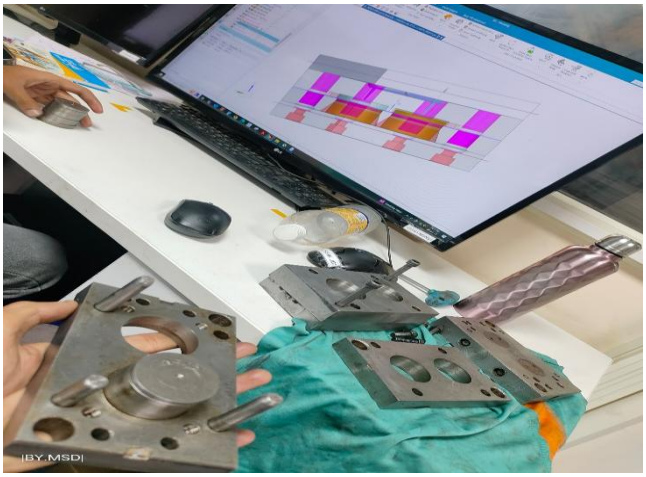

Figure 3 Sectional View