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Design and Analysis of Three Plate Injection Mould

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ABSRACT: The objective of this paper is to design a three-plate injection mould that used to produce the differential cover components which are used in automobile. In the proposed work we are trying to design injection mould that has the capacity to produce thin walled plastic components without warpage defect and also a mould which permits the part to be created in new plane away from gating system to allow sufficient cooling time for the component before ejection. The aim is to create a mould which has flexibility to place gating system anywhere on the mould design. The design of three plate injection mould has done using inspire design software and the analysis software. For manufacturing and study the mechanical behavior of the three-plate injection mould has been carried out for four materials. Out of four materials AISI 304 gives us the better results.

Key words: Injection mould, Automobile, Ansys, AISI 304, materials

I. INTRODUCTION

Injection molding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection molding, which vary greatly in their size, complexity, and application. The injection molding process requires the use of an injection molding machine, raw plastic material, and a mold. The plastic is melted in the injection molding machine and then injected into the mold, where it cools and solidifies into the final part. The steps in this process are described in greater detail in the next section

Injection molding is used to produce thin-walled plastic parts for a wide variety of applications, one of the most common being plastic housings. Plastic housing is a thin-walled enclosure, often requiring many ribs and bosses on the interior. These housings are used in a variety of products including household appliances, consumer electronics, power tools, and as automotive dashboards. Other common thin-walled products include different types of open containers, such as buckets. Injection molding is also used to produce several everyday items such as tooth brushes or small plastic toys. Many medical devices, including valves and syringes, are manufactured using injection molding as well.

II. EJECTION

Mould tool ejection systems vary enormously both in complexity and design. The prime function of any ejector system must be that of clearing the moulded components away from the mould on opening, thus enabling the press to recycle. Once clear of the mould the components free fall under gravity away from the moulding area or are removed by other means, e.g. by robot. Usually situated in the core half of the mould, the ejection system can be actuated by the moulding machine or the opening action of the mould. A few of the most commonly encountered ejection components arc listed and described below.

(a) Ejector ban: The ejector bar mechanically interfaces the mould ejection system with that of the moulding machine. The bar can either be linked to the mould (e.g. by a screw thread) or used as a knocker bur without any mechanical linkage between mould or machine.

(b) Ejector plates: The ejector bar transmits the ejection force as a single point load to the centre of the ejector plates. The applied load is distributed to the various components attached or contained within the plate assembly. Ejector plates must be of rigid construction in order to withstand the relatively high cyclic loads imposed on them during service. If the plates flex or bow under load tool wear may occur which could significantly shorten the mould's service life.

(c) Support pillars and parallel blocks: These components transmit the clamping force from the mould back plate through and about the ejector plate recess directly to the core plate. The support pillars additionally act as guides to locate the ejector plate assembly. The amount of ejection stroke available is determined primarily by the overall height of these two components.

(d) Ejector pins and blades: These headed components are trapped between the ejector plates. The ejector pins and blades are usually positioned within the core assembly, seated in reamed holes and ground flush to the face of the

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core with the ejector plates fully back. Components such as these are subject to considerable wear in use due to the continual rubbing action within the core. Most pins and blades fitted to modern mould tools are standard components, often mass produced and catalog ordered for use. Ejector pins and blades are good examples of the application of standardization in reducing tool maintenance and construction costs.

Two-plate mold with hot runners:

In a two-plate mold with hot runners, the material remains in a molten state through the sprue, and gate and only starts to freeze when it enters the cavity.

Hot runners are ideally suited to multi-cavity molds where the molded parts are small. If there are many small parts, a conventional runner system can waste a lot of material, particularly if no regrind of materials is possible. In a two-plate mold with hot runners, once the material in the cavities has frozen and the mold has been opened, only the molded parts and any cold runners are ejected. When the mold is closed again, the molten polymer that is still in the runners fills the cavity again. Runners in a mold can be a combination of both hot and cold runners.

Two-plate molds with hot runners can be used as an alternative to a three-plate mold because the runners don't need to be ejected. In the following diagram, the injection location for this mold has been placed at the center of the cavity, to avoid marking the part on a visual side; therefore, the runners cannot be positioned on the parting plane.

III. METHODS OF EJECTION

1. **Pin ejection:** cylindrical pins eject the finished component. In the case of square and rectangular components, a minimum of four pins (at the four corners) are required. In the case of cylindrical components, three equidistant pins (i.e., 120° apart) are required. The number of pins required may vary based on the component profile, size and area of ejection. This ejection system leaves visible ejection marks on the finished component.
2. **Sleeve ejection:** This type of ejection is preferred for (and limited to) cylindrical cores, where the core is fixed in the bottom plate. In this system, the ejection assembly consists of a sleeve that slides over the core and ejects the component. No visible ejection marks are apparent on the component.
3. **Stripper plate ejection:** This ejection is preferred for components with larger areas. This system calls for an additional plate (stripper) between the core and cavity plates. To avoid flash, the stripper plate remains in contact with the cavity plate and a gap is maintained between the cavity and core plate. Visible ejection marks are usually not noted on components.
4. **Blade ejection:** This type of ejection is preferred for thin, rectangular cross sections. Rectangular blades are inserted in cylindrical pins (or cylindrical pins are machined to rectangular cross sections) to create an appropriate ejection length for the component. For easy accommodation of the ejection pin head, a counter bore is provided in the ejection plates.
5. **By rotation of core (internal threaded components)—**Used for threaded components, where the component is automatically ejected by rotating the core insert.
6. **Air ejection—**Used to actuate the ejection pin fitted in the core using compressed air. The ejection pin is retracted using a spring.

IV. RESULTS OBTAINED

Structural analysis of AISI 304 material

Fig 1 displacement of three plate injection mould

Fig 2 factor of safety of three plate injection mould

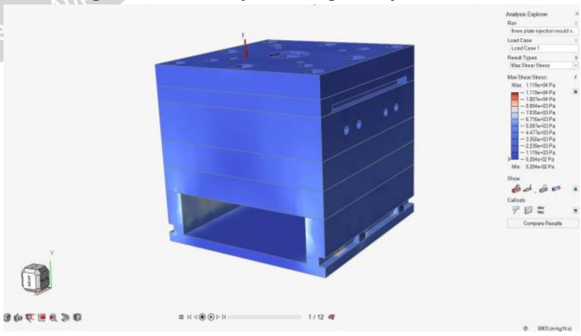

Fig 3 maximum shear stress of three plate injection mould

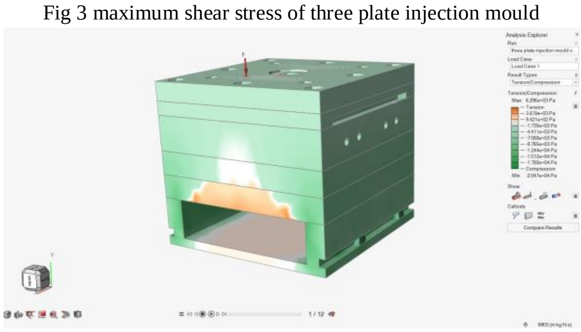

Fig 4 tension/compression of three plate injection mould

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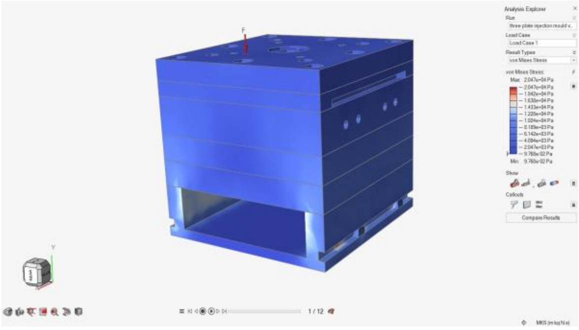

Fig 5 von mises of three plate injection mould

Structural analysis of aluminum 2024 T3 material

Fig 6 displacement of three plate injection mould

Fig 7 factor of safety of three plate injection mould

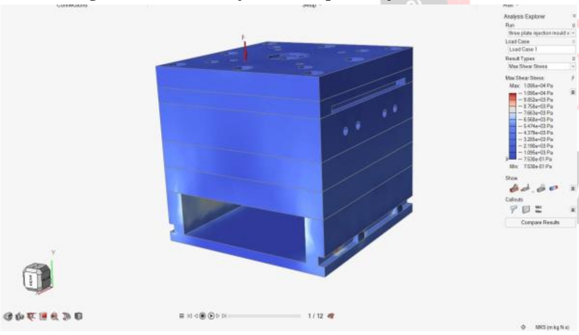

Fig 8 maximum shear stress of three plate injection mould

Fig 9 tension/compression of three plate injection mould

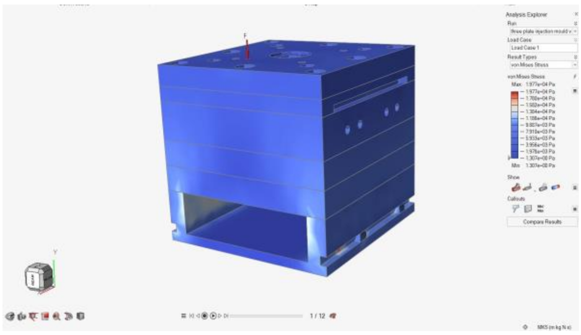

Fig 10 von mises of three plate injection mould

Structural analysis of cast alloy material:

Fig 11 displacement of three plate injection mould

Fig 12factor of safety of three plate injection mould

Fig 13 maximum shear stress of three plate injection mould

Fig 14 tension/compression of three plate injection mould

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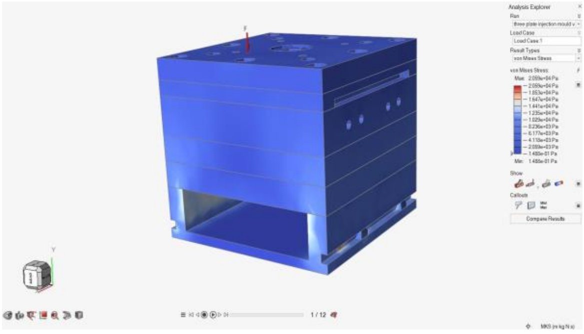

Fig 15 von mises of three plate injection mould

Structural analysis of aluminum EN353 material:

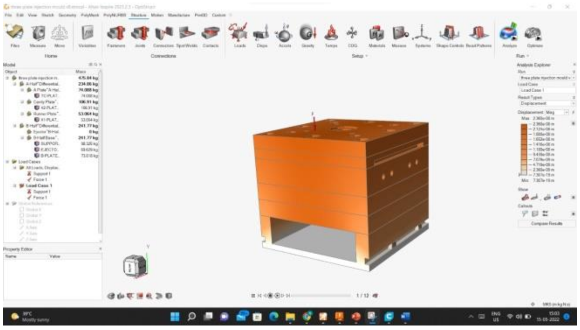

Fig 16 displacement of three plate injection mould

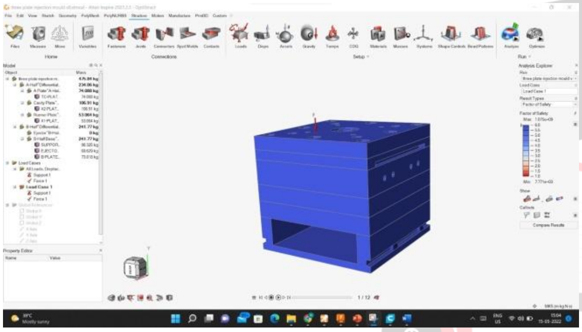

Fig 17 factor of safety of three plate injection mould

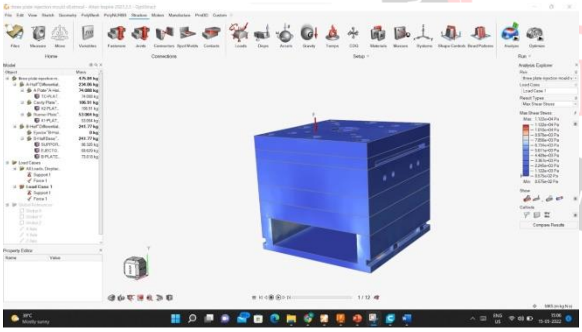

Fig 18 Max sheer stress of three plate injection mould

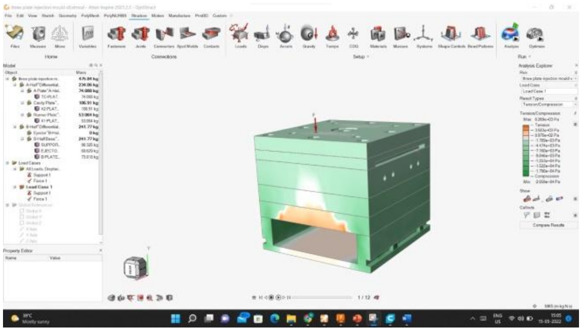

Fig 19 tension/compression of three plate injection mould

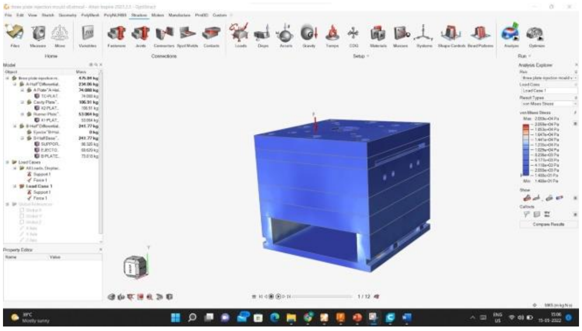

Fig 20 von mises of three plate injection mould

Material	Displacement	Factor of safety	Maximum shear stress	Tension/compression	Von mises stress
AISI 304	1.870E-08m	2.2011e+09	1.119e+04Pa	6.296e+03Pa	2.047e+04Pa
Aluminum 2024 T3	8.086e-08m	1.530e+07	1.095e+04Pa	6.470e+03Pa	1.977e+04Pa
Cast alloy	2.360e-08m	1.075e+09	1.22e+04Pa	6.269e+03Pa	2.059e+04Pa
EN353	2.360e-08m	1.075e+09	1.22e+04Pa	6.269e+03Pa	2.059e+04Pa

V. CONCLUSION

We designed the 3-plate injection mould in the solid works software and performed static structural analysis on the model thus designed. We checked design effectiveness under practical conditions by subjecting it to static load under different material conditions. Out of three materials AISI 304 material shows better results with maximum factor of safety of 2. 201.The design is found to be satisfactory under AISI 304 and other materials failed in factor of safety and von mises stresses. The ejector plate used for the ejection of mould component out of the cavity enhances the component properties as it removes the component after specified cooling is done. Thus, overall design is found to perform well and gives satisfactory results in mass production.

REFERENCES

[1] R.J. Crawford, Rubber and Plastic Engineering Design and Application, Applied Publisher Ltd., 1987

[2] B.H. Min, A study on quality monitoring of injection-molded parts, J. Mater. Process. Technol. 136 (2002)

[3] K.F. Pun, I.K. Hui, W.G. Lewis, H.C.W. Lau, A multiple-criteria environmental impact assessment for the plastic injection molding process: a methodology, J. Cleaner Prod. 11 (2002) 41.

[4] A.T. Bozdana, O¨ . Eyerc´ıog˘lu, Development of an Expert System for the Determination of Injection Moulding Parameters of Thermoplastic Materials: EX-PIMM, J. Mater. Process. Technol. 128 (2002) 113.

[5] M.R. Cutkosky, J.M. Tenenbaum, CAD/CAM Integration Through Concurrent process and Product Design, Longman. Eng. Ltd., 1987

 DOI : 10.35291/2454-9150.2022.0242