Recent Techniques in Design and Manufacturing of Mould (MCCB)

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ABSTRACT

Maraging Injection molding is the most common procedure used to produce plastic parts, and it forms an integral part of a vast array of different processes in most manufacturing sectors. It is commonly used to mass produce a specific part and ensure that all the objects are uniform, which is important for products that are modular and require high precision manufacturing. While many people look to new technologies such as 3D-printing as an innovation that will surpass injection molding as the go-to process to mass produce high volume objects, injection molding is continuously evolving, and there are new trends that will improve upon the process and ensure that the Injection Molding Industry remains in the forefront of manufacturing..

Keyword: - *Cutting Mold Design, Injection Molding, Computerizing Injection Mold, Mold flow analysis.*

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1. INTRODUCTION

One of the most common methods of converting plastics from the raw material form to an article of use is the process of injection molding. This process is most typically used for thermoplastic materials which may be successively melted, reshaped and cooled. Injection moulded components are a feature of almost every functional manufactured article in the modern world, from automotive products through to food packaging. This versatile process allows us to produce high quality, simple or complex components on a fully automated basis at high speed with materials that have changed the face of manufacturing technology over the last 50 years The role of the engineering plastics is increasing in our days in the automotive industry. Aluminum and steel parts are replaced by plastic parts, which generate less overall mass, reduce production costs and environment pollution. Due to these trends the mould maker companies face a considerable challenge in terms of productivity of design and manufacturing and control of project management. The expansion of productivity of design and manufacturing is not conceivable without the application of 3D parametric CAD/CAM systems. These systems have important effect to the design and manufacturing of plastic injection moulds, because they permit to design very complex parts with many freeform surfaces, which was unthinkable in the past. Based on the part model the models of core and cavity are designed by simple processes, and based on it the NC programs are planned too. In this wise the whole design and manufacturing process build on common digital part model, and it allows uniform data handling and the simple and efficient change management. The current article will present the workflow of plastic injection mould design and manufacturing, the subtasks of each steps and the industrial practice of computer support.

2. EXPERIMENTAL DETAILS

• To study the component design with the prospective of a mold designer.

• Identification of molding defects that can occur in a part during injection molding, and ways

To fix and avoid them

• Design and detailing for manufacturing the mold.

Name -Rear housing cover for (Moulded Case Circuit Breakers) MCCB

Type of tool – Two plates

Gate type – Hot tip

No of cavity – 1

Material – Polycarbonate

Production rate required – 12000 per annum

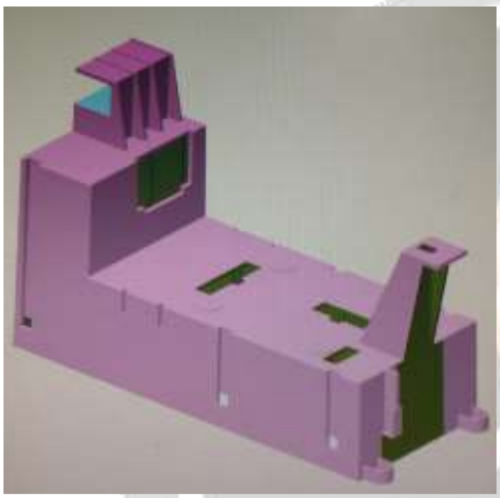
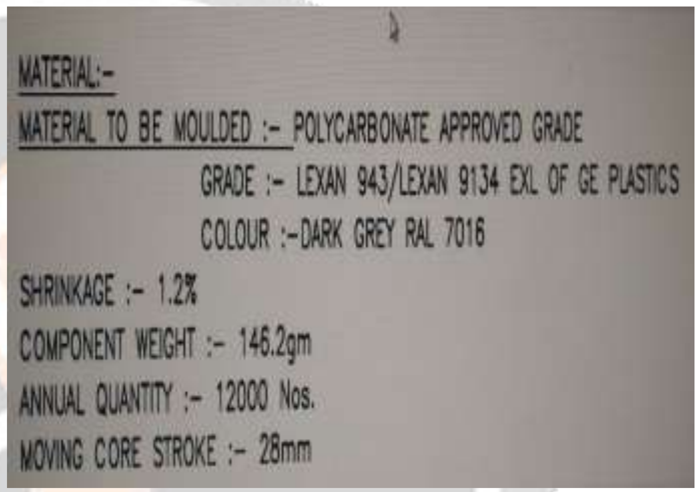


Fig-1 Component



MATERIAL:-

MATERIAL TO BE MOULDED :- POLYCARBONATE APPROVED GRADE

GRADE :- LEXAN 943/LEXAN 9134 EXL OF GE PLASTICS

COLOUR :-DARK GREY RAL 7016

SHRINKAGE :- 1.2%

COMPONENT WEIGHT :- 146.2gm

ANNUAL QUANTITY :- 12000 Nos.

MOVING CORE STROKE :- 28mm

Fig-2 Component details

Table 1.1 Level Material properties

		Borosilicate Glass	Polycarbonate	Silicone
Thermal Properties	CTE (1E-7/°C)	43	650	2750
	Maximum operating temperature (°C)	480	145	200
Optical Properties	Index of Refraction (nD)	1.49	1.58	1.41
	Transmission range	UV-C to near-IR	UV-A to near-IR	UV-C to near-IR
Mechanical Properties	Abrasion resistance	High	Medium	Medium
	Density (g/cm3)	2.3	1.2	1.5
	Tensile strength (MPa)	60	65	11
	Young's modulus (GPa)	64	2	0.002

3. RESULTS AND DISCUSSION

FLOW ANALSIS REPORT.

What is Mold Flow Analysis: Mold X3D software simulates plastic flow, allowing you to enhance mold design and create the highest quality products possible. This analysis provides a virtual sneak peek into how the chosen material will fill a mold's cavities and highlights potential areas of concern. Digitally simulating this process *before* cutting the tool allows changes to be made early on, ultimately saving money and optimizing results.

When Should Mold Flow Analysis be used: MFA should be conducted before tooling production launches. Software can be used to evaluate the mold design to make sure it produce the most consistent and highest quality parts from each cavity of the tool. A virtual model of the mold is created and, using the known data and characteristics of the chosen material, the software is able to predict how the material will flow into and throughout the mold. Different data points can be assessed, including pressure, fill time and melt temperature. Doing so allows for optimization of the process before tool production ever begins

Is Analysis Necessary for Every Application: The short answer: not necessarily. Just because MFA is an available resource doesn't mean it should be utilized for every project. To determine whether MFA should be used for a specific application:

Product geometry: Complex geometries are most likely to benefit from analysis since they are more intricate, and flow is less predictable than with a simpler geometric design.

Tolerance Requirements: Complex geometry, tight tolerances benefit from pre-tooling analysis to ensure a product will meet spec with the selected materials and tooling design.

4. PROCESSING INFORMATION

• Material Name	:	PC
• Grade Name	:	Lexan 943
• Fill Time	:	0.8, 1.0 & 1.2 sec.,
• Melt Temperature	:	305ºC
• Mold Temperature	:	82ºC
• V/P Switch – Over	:	99%
• Analysis	:	Filling

Fill mold cavities consistently and uniformly Figure shows the pressure variation at the exit of the inlet, the maximum pressure of injection was found at the exit of the inlet. A Probe is used to measure the pressure at the point in mold X3D

Section	Discription	Pressure drop			% of overall pressure drop
		MPs	PSI	Bar	
1	Inlet	2.991	433.81	29.91	1.7
2	Nozzle	7.8	1131.3	78	4.4
3	Gate	28.214	4092.1	282.1	15.9
4	H/R Total	39.005	5657.2	390.1	22
5	Cavity	138.286	20057	1383	78
6	Total	177.291	25714	1773	100

FLOW FILLING PRESSURE DROP BREAK UP

5. CONCLUSIONS

In this paper, Rear housing cover (MCCB) is designed. The modeling of component, Core-Cavity design and mold flow analysis is done in mold X3D software the component according to standards by providing shrinkage allowance 1.25%, draft angle 1deg along core side and 1mm radius in all sharp corners are provided. This analysis estimates the total pressure requirements of the molded part and hot runner to be 1773 bar for 1.2 sec.fill time. Part experiences high pressure, which is 78% of total injection pressure. Actual pressure requirements may be significantly influenced by such factors as the grade of resin used, changes in process and temperatures, and part geometry changes such as wall thickness. The injection pressure capability of the intended injection molding machine should be reviewed to ensure that it is capable of achieving the pressure required at the specified injection rate. Some allowance should be made for pressure loss through the injection molding machine nozzle. It is typically recommended not to exceed 80% of the machine’s specified injection pressure capability. This is considered to be a high pressure application. It should be noted that the hot runner is not intended for operation with pressures in excess of 2000Bar.By using the simulation and analysis software Mold flow the above values have been achieved and there were no defects found on the product design.

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7. REFERENCES

[1]. Forouraghi, B. (May 2002), Worst-Case Tolerance Design and Quality Assurance via Genetic Algorithms, Journal Of Optimization Theory And Applications.

[2]. Jeyapaul, R.; Shahabudeen, P; Krishnaiah K. (2005),Quality management research by considering multi-response problems in the Taguchi method – a review, International Journal of Advance Manufacturing Technology,

[3]. Jie-Ren, Shie. (2008), Optimization of injection molding process for contour distortions of polypropylene composite components by a radial basis neural network, International Journal of Advanced Manufacturing Technology.

[4]. Jie Zhu ; Joseph, C. Chen .(2006) Fuzzy neural network-based in-process mixed material-caused flash prediction in injection molding operations International Journal of Advanced Manufacturing Technology.

[5]. Jin Zhang and Suraj M. Alexander, Fault Diagnosis in Injection Molding via Cavity Pressure Signals, Department of Industrial Engineering ,University of Louisville.

[6] Antony, J. 2001. Improving the Manufacturing Process Using Design of Experiments, a Case Study. International Journal of Operations and Production Management. .

[7] Antony, J., S. Warwood, K. Fernandes, and H. Rowlands. 2001. Process Optimization Using Taguchi Methods of Experimental Design. Work Study.

[8] Kumar, A., J. Motwani, and L. Otero. 1996. An Application of Taguchi’s Robust Technique to Improve Service Performance. International Journal of Quality and Reliability Management.
[9] Shaik Mohamed Mohamed Yusof. 2002. Final Year B. Eng. Project. Universiti Teknologi Malaysia.
[10]. C. T. Wong, Shamsuddin-Sulaiman, Napsiah Ismail & A.M.S. Hamouda, “Design and Simulation of Plastic Injection Molding Process“ Pertanika J. Sci. & Techno.
Supplement (2004)

[11]. Fauzun, M. Hamdi , A.E. Tontowi, T. Ariga, Formulation of the size and position of spiral cooling channel in plastic injection mold based on fluent simulation results”. IEEE
2008

[12]. R. Dubay, B. Pramujati and J. Hernandez, “Cavity temperature control in plastic injection molding,
IEEE July 2005

[13]. E O’Neill, C. Wilson and D. Brown, “The benefits of solid modelling in the plastics injection molding industry”, IEEE April 1997
[14]. M. Dastagiri , M. Prasad and M Annamacahrya , ”Application of Axiomatic Design in injection molding process,” IEEE 2010
[15]. Chi-Huang Lu and Ching-Chih Tsai,“Multivariable Self- Tuning Temperature Control for Plastic Injection Molding Process,“
[16]. C.G. Li, Yuguang Wu,“Evolutionary optimization of plastic injection mould cooling system layout design,“ IEEE 2010
[17]. Zhou Chun-ying, Wang Li-tao,“ Injection Mold Design based on Plastic Advisor
Analysis Software in Pro/E,“ IEEE 2011

[18]. B. Bona, L. Giacomello, C. Greco, A. Malandra,“Position Control of a Plastic Injection Moulding via Feedback Linearization Machine“, Arizona December 1992
[19]. R. G. W. Pye,“Injection Mold Design an introduction and design manual for the thermoplastic industry“.
[20]. https://www.researchgate.net/publication/265749741_Injection_Molding_Handbook