

Defects and Solution of Plastic Parts during Injection Moulding

Rahul R. Katkhede¹ Abhijeet A Raut² Kalyan Labade³

¹Student ²Assistant Professor ³Industry Supervisor

^{1,2}Department of Mechanical Engineering

^{1,2}G. H. Raisoni College of Engineering, Nagpur, India ³S.P. Auto Engineering, Pune, India

Abstract— Plastic injection moulding is the biggest part of the business in the world. In the injection moulding largely used polymer processing method due to the more production and low cost of the product. It is much difficult to set excellent process parameter which may causes defects in the product or components such as shrinkage, burn mark, pin mark, flash, warpage and also causes many defects. This paper is on the literature review and study of defects occurs in the plastic injection moulding. There are many reasons to reducing defects in the product. Such problem arises when injection mould is not design properly. This research used the experimental design of Taguchi method to determine the injection moulding conditions, and the injection processes were simulated using the commercial software C-MOLDTM. Both moulding process conditions and factors were discussed regarding the degree of warpage of a thin shell part.

Key words: Plastic, Injection Moulding

I. INTRODUCTION

In the plastic injection moulding the quality of product is depend on the material characteristics and mould design and the process conditions defects in the dimensional stability of parts result in shrinkage. One of the main goals in injection moulding process is the improvement of quality of moulded product besides the reduction of cycle time, and lowest production cost. . It is much difficult to set excellent process parameter levels which may cause defects in the parts and product or component, such as shrinkage and warpage also cause many defect. In the mold, the plastic deformation of the main factors considers that is gating system, cooling system and injection system. There are three major benefits of the process redesign effort. First, closed loop pressure control has enabled tight coupling between the mass and momentum equations. This tight coupling allows the direct input and the controllability of the melt pressure. The Second use of multiple melt actuators provides for the de-coupling of melt pressure between the different locations in the mould cavity. Third, the heat equation has been decoupled from the mass and momentum equations. The procedure of injection moulding is described as follows. Firstly, the raw material is heated to its melting temperature. By high pressure, the melted polymer is injected into the cavity via a delivery system and a gate. When filling is nearly completed, the cavity is maintained at a constant pressure for the packing stage.

II. LITERATURE REVIEW

The experimental study on the defects occur in injection moulding

A. Amit Kumar et.al (2002)

This paper give details with the computer simulation of injection mould-filling at flow rate during the production of a cylindrical part under isothermal and non-isothermal

conditions. The material of the object is low density polyethylene (LDPE) power-law viscosity of LDPE is also a function of temperature. The material of the mould is steel. The concept of melt-mould thermal contact resistance coefficient has been incorporated in the model for the non-isothermal filling conditions.

B. Chun-Sheng et.al (2007)

This paper investigates the influence of processing conditions on the weld line strength of thin-wall Acrylonitrile Butadiene Styrene Copolymer (ABS) parts. It is well know that the wildling reduces the mechanical performance of the conventional injection moulded parts. Yet systematic researches and reports on wildling strength of thin-wall moulded parts are still not sufficient

C. Bohai He.(2008)

This paper is about material selection and heat treatment of the plastic mould. The main failure modes of the plastic mould surface wear, deformation and fracture. The failure reasons is depend on working condition of mould materials and heat treatment. The working conditions of the plastic mould are complex. They touch directly with the plastic, withstand the pressure, temperature, frication and corrosion and so on.

D. Chao-Chyun et al. (2008)

In this paper they have shown the different defects occurrence in injection moulded parts of metal including weld line, flow mark and solid skin. In this study, a thin wall cavity is designed as flow path for plastic injection mould. The injection moulding tests were performed by using metal mould and stereo lithography mould to compare with the flow behaviour and defects occurrence of flat parts. This experiment was perfumed the various process parameters to investigate the defects parts occur in Injection moulded parts.

III. INJECTION MOULDING PROCESS

Injection moulding is a manufacturing process for plastic parts product both plastic materials that is thermoplastic and thermosetting. Material is fed into a barrel and barrel is used for maintain the high temperature and material mixed, and by the help of reciprocating screw forced into a mould cavity reciprocating screw is also called ram injector. Where it cold and tough to the configuration of the mould cavity moulds is generally made by steel or aluminium, and precision machined to form the features of the desired part. Injection moulding is largely used for manufacturing different parts, from the smallest part to largest part like the cars body panels and it can use in medical field. Injection moulding is the common method of production component, with some common made items including electronic body components to outdoor furniture and also more parts.



Fig. 1: Electronic 100ton Fanuc roboshot injection moulding machine

Injection moulding machines used hopper for material, a ram injection and a heating unit. They are also known as presses, they hold the moulds and components and shaped component formed. Injection moulding machines have many components are available in different configurations including a horizontal configuration and a vertical configuration. There are the two types if injection moulding machine i.e. horizontal and vertical.

Presses are depending on the tonnage, which depend on amount of clamping force that the machine can exert that force. This force keeps the mould closed during the injection process. Tonnage can vary from less than 6 tons to over 9,000 tons, with the higher figures used in comparatively few manufacturing operations. The clamp force needed is determined by the area of the part being moulded.

IV. CAUSE AND EFFECT DIAGRAM FOR INJECTION MOULDING

The main reason for defect occurs in injection moulding is the design mould, and process parameters, machine, operator or material. The details are shown in fish bone diagram Cause and effect diagram shown in below fishbone schematics. There are many reasons that affect the quality of moulding parts. Taguchi's philosophy is an efficient tool for the design of high quality manufacturing system. Dr. Genichi Taguchi is a Japanese quality management consultant has developed a method based on orthogonal array experiments, which provides much lower variance for the experiment with optimum setting of process control parameter. Thus the consolidation of design of experiments with parametric optimization of process to obtain desired results is achieved in the Taguchi method.

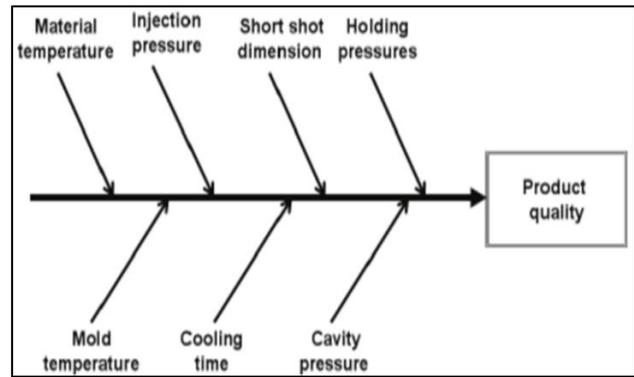


Fig. 2: Fishbone Schematic

The Taguchi method attempts to optimization a process or product design and is based upon three stages, as follows:

- Concept Design
- Parameter Design
- Tolerance Design

The concept design is considered to be the first phase of the design strategy. In parameter design, the best setting of the control factors is determined. This is the important step, as it does not affect the unit manufacturing cost of the product. Third is the design step and is exercised when further improvements are required for the optimized design.

V. IDENTIFY DEFECTS IN PARTS/PRODUCT IN INDUSTRY INTERNSHIP

There are many defects occurs in plastic injection moulding that is silver mark, sink mark, burn mark, pin mark, glossy, weld line and many more I observed that defects in the parts and solution on it we disuse about below.

Mould seal clearance, inappropriate clamping force and melting temperature along with no uniform setting times play the role in lower product quality. Besides, the usage of low grade polymer with inappropriate mass-mass ratio would also be a non-conformance in the production of a quality product. The following below are some of the problems that might arise in the production line. These researches are done by ExxonMobil Chemical Company for the material Polypropylene (PP). This list will highlight problem areas of Injection Moulding and a typical cause and method of resolving that problem. We take some examples in below for the understanding how to solving defects in injection moulding.

A. Flash occurs on the Plastic Parts

1) Why it occurs?

Flash is occurs due to when the Molten plastic is flowing into unwanted sections of the mould cavity



Fig. 3: Grill 609 (assemble parts of air vent housing)

2) *Solution on it:*

- Check for mould shut off or mould damage
- To Decrease injection speed
- To Decrease mould temperature
- To Decrease melting temperature

B. *Burn Mark occurs on the plastic parts*

1) *Why it occurs:*

When the air and gas is not pass inside the mould cavity during plastic injection, the high pressure results in the dieseling of the plastic result in the burning of the product.



Fig. 4: Washer

2) *Solution on it:*

- To Decrease melting temperature
- To Decrease injection speed
- To Increase venting in the mould
- To Decrease screw rotation speed

C. *Shot mould /shot fill occurs in the plastic parts*

1) *Why it occurs:*

When the Molten plastic is not reach the mould cavity section then shot mould is occurs.



Fig. 5: air vent assemble part

2) *Solution on it:*

- To Increase melting temperature
- To Increase mould temperature
- To Increase injection speed
- To Increase injection pressure

D. *Shrinkage occurs on the plastic part*

1) *Why it occurs:*

Plastic is shrinking when it cools but additional plastic cannot be for further compensation of the shrinkage.



Fig. 6: RR Bracket

2) *Solution on it:*

- Increase pack and hold pressures
- Increase pack and hold times
- Decrease mould temperature
- Decrease melting temperature

VI. CONCLUSION

The proper tool design is necessary to the perfect and good product, which is required in medical, Automobile and electrical industry. In this seminar we have studied, problems in moulded parts, solution for mould parts or product. In the design of mould and tooling different parameters are consider like analysis of mould flow, injection pressure, material of the mould temperature. This article presents a review of research in the determination of the process parameters for injection moulding. The various research works based on various approaches including mathematical model, Taguchi technique Artificial Neural Networks Case Based Reasoning a review of literature on optimization techniques has revealed that there are, in particular, successful industrial applications of design of experiment based approaches for optimal settings of process variables. Taguchi approach has potential for savings in experimental time and cost on product or process development and quality improvement. There is general agreement that offline experiments during product or process design stage are of great value. Reducing quality loss by designing the products and processes is to be insensitive to variation in noise variables is a novel concept to statisticians and quality engineers

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