A Review on Defect Reduction in Injection Moulding

Ravish Kumar[1] Amit Kumar Tanwar[2]
[1]M. Tech Scholar [2]Professor
[1,2]Department of Mechanical Engineering
[1,2]Roorkee Institute of Technology Roorkee-247667, Uttarakhand, India

Abstract— Today's competitive environment has, lower manufacturing cost, more productivity in less time, high quality product, and defect free operation are required to follow to every organization. Flash, unfilled sections, blow holes, hot tearing and ejector marks are common die casting defects. These defects directly effect on productivity, profitability and quality level of organization. Pressure die casting process is still state of art with experienced people, but these experience needs to be transformed in engineering knowledge for the better growth of the moulding industries.

Keywords: Define Measure-Analyze-Improve-Control, Defects In Keeping With Million Opportunities, Analysis Of Variance, Mean Square Deviation

I. INTRODUCTION

The DMAIC is both a philosophy and a methodology that improves quality by analysing data to find root cause of quality problems and to implement controls. Although DMAIC implemented to improve manufacturing and business, processes such as product design and supply chain management. It is a business improvement strategy used to improve profitability to drive out waste in business process and to improve the efficiency of all operation that meet customer's needs and expectation. DMAIC is a customer-focused program where cross functional teams works on project aimed at improving customer satisfaction. It is a scientific method to improve any aspect of a business, organization process.

DMAIC is a methodology to

1) Identify improvement opportunities.
2) Define and solve problems
3) Establish measures to sustain the improvement.

Six- Sigma is a statistical measurement of only 3.4 defects per million. Six-Sigma is a management philosophy focused on eliminating mistakes, waste and rework. It establishes a measurable status to achieve and embodies a strategic problem-solving method to increase customer. Satisfaction and dramatically reduce cost and increase profits. Six-Sigma gives discipline, structure, and a foundation for solid decision making based on simple statistics. The real power of Six Sigma is simple because it combines people power with process power. The Six Sigma is a financial improvement strategy for an organization and now a day it is being used in many industries. Basically it is a quality improving process of final product by reducing the defects; minimize the variation and improve capability in the manufacturing process. The objective of Six Sigma is to increase the profit margin, improve financial condition through minimizing the defects rate of product. It increases the customer satisfaction, retention and produces the best class product from the best process performance.

If an organization is focused on customer satisfaction, then Six Sigma will offer a method and some tools for the identification and improvement of both internal and external process problems to better meet customer needs by identifying the variations in organization's processes that might influence the customer's point of view, negatively.

Six Sigma is the powerful force by which leading corporations such as GE, Motorola and Ford are delivering staggering results to their bottom line and customer satisfaction through fundamental changes in the way they operate and an overall improvement in the products and services they deliver. These leading companies believe so much in Six Sigma that they are willing to invest 100's of millions of dollars in Six Sigma with the expectation to receive billions of dollars in return.

Six Sigma places the emphasis on financial results that can be achieved through the virtual elimination of product and process defects. Gone are the days of quality at any cost. Today's quality improvement programs must deliver measurable results, short and long-term, to operational effectiveness and the bottom line. The logical end of this approach is that as product and process defects are driven out, value for the customer goes up, customer satisfaction increases, the company captures the market with higher quality at lower price, and profits and company stakeholder value is maximized.

II. LITERATURE SURVEY

MohitChhikara (2017) presented the literature-assessment of the works already carried out inside the discipline of Six Sigma Implementation by using the various authors till now. The findings of this paper might be the premise of my similarly research in this field with the aid of developing suitable research technique needed to achieve the targets set via me for my research work. [1]

RajatAjmera and Valase K.G. (2017) explore using DMAIC methodology of six sigma to decrease the defect in a specific textile industry. That is a scientific technique in the direction of defects minimization thru 5 stages of DMAIC technique named defines, measure, analyze, improve and control. Special six sigma equipment were utilized in different levels. Pareto analysis was done to identify the predominant kinds of defects. Root causes of those defects were detected via cause and effect analysis. In the end a few ability answers are counselled to conquer those causes. The result determined after implementation of the solutions is very large. Enhancements within the satisfactory of strategies result in cost reductions in addition to service upgrades. The defect percent has been reduced from 7.4 to 5.08 % and therefore the Sigma stage has been progressed from 2.9 to a 3.2.[2]

Jitendra A Panchiwala (2015) carried out the research work made by using several researchers and an try to get technical solution for minimizing numerous casting defects and to enhance the entire process of casting production.[3]

C. Manohar and A. Balakrishna (2015)discusses the quality and productivity development in a manufacturing industry through defect analysis and offers with an application of Six Sigma DMAIC (define–degree-analyse-improve-manipulate) method in wheel production plant which offers a framework to become aware of, quantify and remove assets of variant in an operational system in question, to optimize the operation variables, enhance and maintain performance viz. process yield with well completed control plans to reduce defects occurring in cast wheel manufacturing. [4]

Ghazi Abu Taher& Md. Jahangir Alam (2014) reveals out the effective manner of enhancing the great and productivity of a manufacturing line in production enterprise. The goal is to perceive the disorder of the company and create a higher answer to enhance the manufacturing line performance. Various commercial engineering technique and gear is implementing on this examine so as to research and solve the trouble that happens inside the production. But, 7 excellent manipulate equipment are the primary tools in an effort to be carried out to this observe. Records for the chosen assembly line manufacturing facility are amassed, studied and analysed. The illness with the very best frequency will be the primary goal to be stepped forward. Various reasons of the defect can be analysed and various solving technique might be present. The high-quality fixing approach can be chosen and recommend to the agency and examine to the preceding result or production. But, the implementation of the solving techniques is depending at the employer whether or not they wanted to apply or not. [5]

Darshan D. Patel (2014) presented a Six Sigma project, undertaken within company for production in bearings, which deals with identification and reduction of production cost & process. [6]

S. Chandra (2014) determined that continuous improvement is one of the prime factor for effective implementation of Total Quality Management in an organization. Continuous improvement encompasses the involvement of human beings and systematic technique for tackling the problems related to the great of product /offerings and the processes. There are numerous methods and strategies to be had for systematic analysis of the troubles and additionally result in answer of the equal. This paper offers with the problem of low yield / higher stage of rejection in Glass Neck (used as part of picture Tube in tv enterprise) forming method and development of the yield of output through systematic involvement of humans as a group and adopting Six- Sigma methodology.[7]

Pramod A. Deshmukh& A. B. Humbe (2014) decreased tool changing time at grinding wheel station. This problem became rectified to an excellent extent the usage of Metrics, why? Why? Analysis and root cause analysis strategies. This work is expected to growth wide variety of Six Sigma users after the impact of this end result at the performance of the firm. The work is carried out at Tulja Engineering Aurangabad, a Medium scale manufacturing unit.[8]

III. Materials

Die casting typically makes use of non-ferrous alloys. The four most common alloys that are die cast are shown below, along with brief descriptions of their properties.

– Aluminium alloys
– Copper alloys
– Magnesium alloys
– Zinc alloys

The selection of a material for die casting is based upon several factors including the density, melting point, strength, corrosion resistance, and cost. The material may also affect the part design. For example, the use of zinc, which is a highly ductile metal, can allow for thinner walls and a better surface finish than many other alloys. The material not only determines the properties of the final casting, but also impacts the machine and tooling. Materials with low melting temperatures, such as zinc alloys, can be die cast in a hot chamber machine. However, materials with a higher melting temperature, such as aluminium and copper alloys, require the use of cold chamber machine. The melting temperature also affects the tooling, as a higher temperature will have a greater adverse effect on the life of the dies.

IV. Die Design

In addition to these many types of channels, there are other design issues that must be considered in the design of the dies. Firstly, the die must allow the molten metal to flow easily into all of the cavities. Equally important is the removal of the solidified casting from the die, so a draft angle must be applied to the walls of the part cavity. The design of the die must also accommodate any complex features on the part, such as undercuts, which will require additional die pieces. Most of these devices slide into the part cavity through the side of the die, and are therefore known as slides, or side-actions. The most common type of side-action is a side-core which enables an external undercut to be molded. Another important aspect of designing the dies is selecting the material. Dies can be fabricated out of many different types of metals. High grade tool steel is the most common and is typically used for 100-150,000 cycles. However, steels with low carbon content are more resistant to cracking and can be used for 1,000,000 cycles. Other common materials for dies include chromium, molybdenum, nickel alloys, tungsten, and vanadium. Any side-cores that are used in the dies can also be made out of these materials.

Fig. 1: Die assembly

V. MACHINE SPECIFICATIONS

Both hot chamber and cold chamber die casting machines are typically characterized by the tonnage of the clamp force they provide. The required clamp force is determined by the projected area of the parts in the die and the pressure with which the molten metal is injected. Therefore, a larger part will require a larger clamping force. Also, certain materials that require high injection pressures may require higher tonnage machines. The size of the part must also comply with other machine specifications, such as maximum shot volume, clamp stroke, minimum mold thickness, and platen size.

Die cast parts can vary greatly in size and therefore require these measures to cover a very large range. As a result, die casting machines are designed to each accommodate a small range of this larger spectrum of values. Sample specifications for several different hot chamber and cold chamber die casting machines are given below.

Type	Clamp force (ton)	Max. shot volume (oz.)	Clamp stroke (in.)	Min. mold thickness (in.)	Platen size (in.)
Hot chamber	100	74	11.8	5.9	25 x 24
Hot chamber	200	116	15.8	9.8	29 x 29
Hot chamber	400	254	21.7	11.8	38 x 38
Cold chamber	100	35	11.8	5.9	23 x 23
Cold chamber	400	166	21.7	11.8	38 x 38
Cold chamber	800	395	30.0	15.8	55 x 55
Cold chamber	1600	1058	39.4	19.7	74 x 79
Cold chamber	2000	1517	51.2	25.6	83 x 83

Fig. 2: Die casting machine –Specification

VI. CONCLUSION

In this research investigated how best manufacturing industries can find a way to control or limit defects through Six Sigma program. Six Sigma DMAIC approach has been greatly used for measurable examination of the problem. Taguchi's robust design was utilized as improvement strategy to find ideal process parameter settings. L9 OA-based experimental design was completed to consider the variations in die casting process at various levels of the process parameters.

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