Analysis of casting defect and methodologies adopted for defect reduction/quality improvement- A Review

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Abstract

In today's world of rapid globalization, foundry industries of India play a key role of production goods by using casting process. Today is the era of customer driven market, due to this industries are needed to produce defects free product and processes to satisfy customer requirements. Casting process is the most widely used process in industry specially in the filed of Automotive product manufacturing but defect free casting poses a critical threat in its development as compared to other manufacturing approaches.Casting involves various process like mould making, core making, melting , pouring, and solidification. Casting have one or more defects and these defects may be the the result of single cause or combination of causes.These defects increase the rate of scrap and increase overall production cost.Some defects can be tolerated while others can be repaired, otherwise they must be eliminated. The aim of this paper is to review the existing research progress in the field of foundry and methodologies adopted to produce defect free casting.

***Key words**: Defect, Defect Prevention, Methodologies for defect free casting.*

1. Introduction

In today's world of rapid globalization and competitive business environment of 21st century, various challenges have put companies under increasing pressure to improve their performance and become a global competitive by achieving business excellence. As the current market is fully customer centric, companies are needed to produce the products which are as per customer requirement. For competing in such a market, companies are required to adopt the continuous improvement methodology which is focused on the quality and capable of producing the products defect free. Quality of casted part can be improved through critically selecting the process parameters. Therefore primary objective of this review study is to explore the possible arises during foundry practice and focusing on the process and design parameters which are responsible for the generation of defects.

2. Casting Defects

Casting defects are usually not accidental, but due to improper control of manufacturing. The major defects generally found in casting are as follows:

1. Gas defects
2. Shrinkage cavities
3. Moulding material defects
4. Pouring metal defects
5. Metallurgical defects
6. Moulding and core box defects

Gas defects

- **Blow holes/open holes**

Spherical shaped gas cavity are due to the moisture left in the mould and the core. Due to the heat of molten metal, the moisture is converted into the steam, a part of which may entrapped in the casting. On the surface they are called open blow holes.

- **Pinhole porosity**

Release and entrapment of air gases release when molten metal gets in contact with green sand mold.this air gases are entrapped when molten metal is poured in the mold.

Shrinkage cavities

These are caused by the liquid shrinkage occurring during the solidification. To compensate this, proper feeding of the liquid metal is required.

Moulding material defects

- **Scabs**

These are the projections on the casting which occur when liquid metal penetrates behind the surface layer of the sand.

- **Swell**

It may occur due to insufficient ramming of the sand, pouring the molten metal too rapidly.

- **Run out**

These permit drainage of metal from cavity and result in incomplete castings.

Pouring metal defects

- **Misrun**

A casting that has solidified before completely filling mold cavity.

- **Cold Shut**

Metal splatters during pouring and solid globules form and become entrapped in casting.

Metallurgical defects

- **Hot Tears and Hot Cracks**

These are the internal and external ragged cracks on the casting surface.

- **Hot Spots**

These are caused by chilling of the casting.

Moulding and core box defects

- **Mismatch**

Mismatch in mold defect is is because of the shifting molding flashes. It will cause the dislocation at the parting line.

3. Literature Survey

Drd.ing.Sorina Moica, Drd.ing.Raluca Farcas and Ing.Paula Monica Nasalean (2009) investigated the problem of porosity in early stage of product development of die casting. Author analysed this type of defect in car component production company in Japan. For removing the defect Taguchi method employed. After implementation of this method, there is reduction in percentage of parts which have have porosity.

B.R.Jadhav, Santosh Jadhav (2013) in this paper casting defect namely pouring metal defect (cold shut) is diagnosed for its causes. Author analysed that cold shut defect in casting is reduced by controlling the pouring temperature and allow composition. For finding the root cause of this defect seven quality control tools are used.A systematic approach for rejection control using seven quality control tools is discussed in this paper. Here in this case alloy composition and pouring temperatures were the root causes of the problem. Total rejection is reduced to 6.6% from 12.3%.

Aniruddha Joshi, L.M.Jugulkar (2014) investigated the problem of various casting defects such as cold shut, porosity, shrinkage , mould crush. Author analysed these defects plotted in Pareto diagram. Then it also uses Ishikawa diagram for relationship between causes and effects and found that the high pouring temperature ensures the elimination of porosity, shrinkage.

Prasan Kinagi, Dr. R.G Mench (2014), in this paper **d**esign of experiment and FMEA techniques are combined to analyze casting defects. Casting Defects can be minimized with optimal level settings of process parameters. Pareto principle is used to identify and evaluate different defects and causes for these defects responsible for rejection of components at different stages of manual metal casting operations. The correct identification of the casting defect at initial stage is very useful for taking remedial actions.

Avinash Juriani (2015) in this study the various causes and remedial measures are suggested by using cause and defect analysis concept. This study will be highly useful in reducing casting defects in foundry.

Sunil Chaudhari, Hemant Thakkar (2014) modern method of casting components using various software and simulation technique is really a boost for casting quality and improvement in casting yield.

Uday A. Dabade and Rahul C. Bhedasgaonkar (2013) have used two techniques are used for the analysis of the casting defects. In this study they have used a Design of Experiment (Taguchi method) for analysis of sand and mould related defects like as sand drop, bad mould, blow holes, cuts and washes, etc. and another method is computer aided casting simulation technique stem, which is used for meth ding, filling and solidification related defects such as shrinkage porosity, hot tears, etc.With

Taguchi optimization method the percentage rejection of castings due to sand related defects is reduced from 10 % to 3.59 %.

Conclusion

It is concluded from available literature that simulation practices are best amongst other tools as it saves time as well as capital investment before commencement of actual production. The other approaches are also beneficial such as Pareto analysis, design of experiments, DMAIC (Define, Measure, Analysis, Imrove, Control), cause and effect diagram to analyse the current scenario of casting defects for enhancing the quality of cast product.

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