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REVIEW ON ANALYSIS OF FOUNDRY DEFECTS FOR QUALITY IMPROVEMENT

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Abstract

In the changing global scenario, the foundry industries need to be environmentally friendly and to perform efficiently by reducing the number of rejections and should ensure quality products delivered. Some foundry industries are working with trial-and-error method and also undertaking research activities to ensure maximum output. Small scale industries found difficulty in undertaking research activities due to economic constraint. Large industries should transfer technologies to small foundry industries and further development can be made. The demand for defect free castings with minimum costs is increasing. This study is aimed to review the research made by several researchers in the field of reducing casting defects using FMEA, six sigma, quality control tools, Taguchi technique method and improve the casting process both qualitatively and quantitatively.

Keywords: Casting Defect, FMEA, Six Sigma, Quality Control Tools, Taguchi Technique.

1. INTRODUCTION

Foundry industries often suffer from defects due to high rejection. Casting process is also known as process of uncertainty. Because the cause of defects is a combination of several factors. Therefore, it becomes important to identify the cause of the problem accurately to find the best solution. FMEA, six sigma, quality control tools, Taguchi technique method help to examine each step in the process and enable us to detect the cause of the problem effectively. This research is based on analysing various techniques employed by researchers to reduce the casting defects in the foundry process.

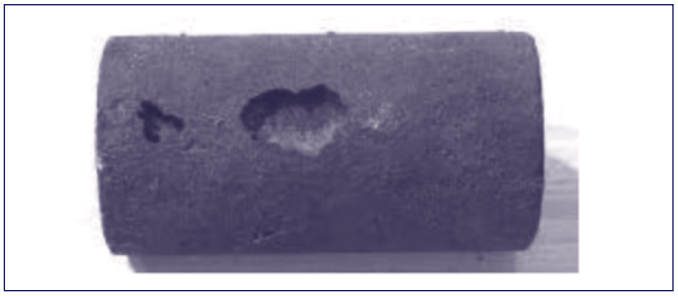
2. CASTING DEFECTS

Blowhole, Open holes, Shrinkage, Cuts and washes, Fusion, Run out, Swells, Drops, Pinholes, Rat tails, Veins, Hot tear/ crack, Hot/hard spots, Cold shots, Sand inclusion, Shift/ mismatch, Flash, fin and burrs, Warping

3. REVIEW OF LITERATURE

3.1 Review of blowhole

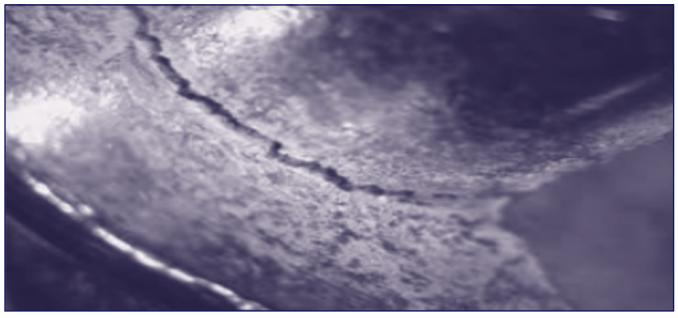
Figure 1. Blowhole defect [10]



- By analysing the article, moisture left in mold and core cause internal voids and depression, this blow hole defect can be corrected by FMEA technique, and the result obtained is modify gating to reduce turbulence, use sivex filter. [2]
- This article explains that less die/core pins temperature causes blow holes or cracks at serration lines, and more die/ core pins temperature causes shrinkage at inner diameter, by using FMEA analysis pre heat the dies and pins before casting. [4]
- The gases inside the molten metal from a large, spherical cavity. The major failure entrapment of gases, low permeability and moisture absorbed by cores. Defect are identified in simulation process. Simulation aids in the production of defect-free casting in a timely manner. [10]
- In this paper, using six sigma, DMAIC, The use of the six-sigma technique to reduce casting defects yielded excellent results in terms of minimising production wastes. Because of the high moisture level in the greensand utilised in moulder, the sand's organic content is low. [15]
- This research demonstrated the use of a six-sigma methodology to identify difficulties during the casting process and to remedy the problem by determining the best operating setting for eliminating sand inclusion defect. The amount of blow hole rejection in casting parts has been successfully lowered from 28.3% to 7.1%. [12]

3.2 Review of crack

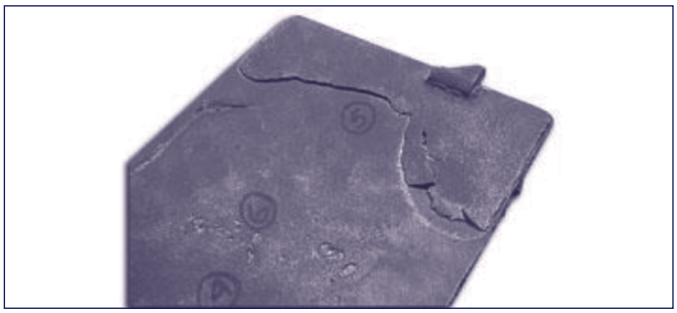
Figure 2. Crack [10]



- In this paper, using FMEA method, the defects are identified in advance and corrected. Here RPN level is 90 and this can be improved by various preventive measures like providing clams for the plate will avoid cracks in core, cleaning the core box after every use will prevent the cracks and damage of upcoming cores. [1]
- This article analysis shows that the defect of crack may have arisen due to high residual stresses or due to weld line weaknesses, by using FMEA analysis the defect can be minimized by minimizing residual stress and to recommend the maximum shear stress, if the defect is due to differential shrinkage, we can minimize the same and we can improve product quality. [3]
- During the melting process, casting disqualification may arise due to wrong chemical composition of iron, which may be due to wrong cupola loading, wrong conducting of melting process and FMEA analysis recommends that control of chemical composition and liquid metal temperature can reduce the defect. [6]

3.3 Review of Cold shots

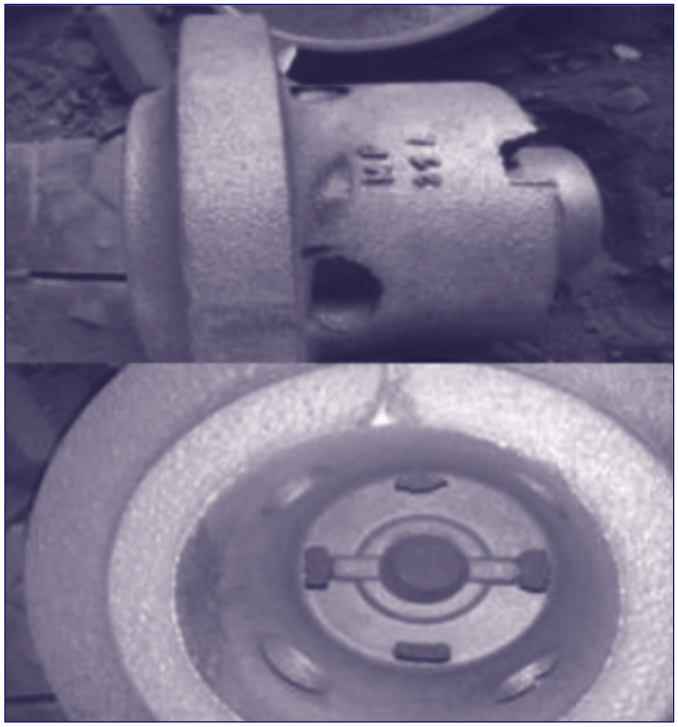
Figure 3. Cold shot [14]



- Due to rapid solidification, the defect of cold metal arises, and the defect can be minimized by using FMEA technique and the result increase die temperature or improve venting. [2]
- In this paper, using quality control tools method, the defect is identified in each and every steps. Major casting defect are found in cold shot, potential cause for failure is delayed pouring and improper venting. The remedies to failure are for replace manual hand ladles with automatic monorail system for smooth and timing pouring. Maintain a pouring temperature of 1418°c to 1432°c rather than the current 1450°c to 1470°c [8]
- This article analysis shows that the defect of cold shot due to incomplete union of two metal flesh steams, before the mould is full, the metal freezes too chilly to die. Using statistical quality control tools, fish bone, lean six sigma. Remedies for cold shot defect is raise the temperature of the liquid being poured, improve the temperature of the die or the venting. [14]
- Upon analysis the paper it becomes clear that cold shot may arise due to reasons such as lack of molten metal fluidity, faulty design and by improving the design & maintaining sufficient pouring temperature [7]
- This paper analysis show how seven basic tools of quality is used to correct the defect of cold shut and various causes that are identified include thin section, thin walls of materials, slow intermitter pouring or damaged pattern in machines and because of the increased pouring temperature, a temperature range of 1418c to 1432c was discovered, which could be effective in reducing cold shut. [9]

3.4 Review of sand inclusion

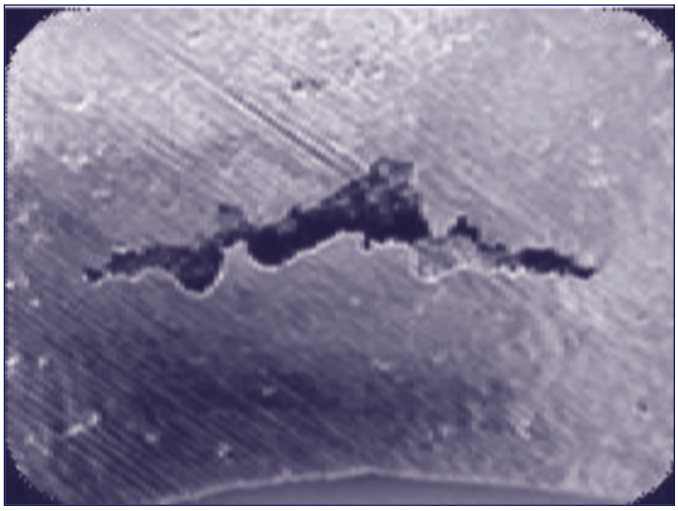
Figure 4. Sand inclusion [11]



- During inclusion of sand, improper ramming of sand results in sand inclusion defect which can reduced by FMEA analysis, and the results obtained were proper mixing ratio of reclaimed sand and binder. [2]
- According to a statistical investigation of the casting process, mould conditions account for around 55% of the flaws in casting products. According to failure mechanism and effect analysis of the mould defects, the sheer strength, hardness, and permeability of the mould can all be modified by changing the mould composition. [5]
- The application of six-sigma DMAIC technique to detect difficulties in a casting process and solve the problem by establishing the best operating parameters for reducing sand inclusion defect was gives in the study, like fish bone diagram, DMAIC. [11]
- In this article, the quality control is major roll to decreasing defect. Tools such as the pareto chart and the cause-and-effect diagram are used to detect and classify the causes of defects in the manufacturing system, as well as to decrease them using a variety of corrective actions, the result for sand inclusion has been lowered from 1.74% to 0.81%. [16]

3.5 Review of shrinkage

Figure 5. Shrinkage defect [10]



- This article analysis shows that the defect of shrinkage are improper composition, improper ramming of mold box and pouring temperature. by using quality control tools, Remedial issues are suggested for minimization of these losses. Use an automatic mould box production equipment or properly clamp the mould box on the mould machine. [8]
- By analysing the article Due to a lack of design and insufficient input metal, this problem occurs. A vacuum in the casting might be caused by shrinkage. Solution for failure is proper speed of filling process and modification of design. [10]
- The articles explains that the defect of shrinkage in casting is caused due to uneven cooling rate or due to abrupt change in cross sectional area and insufficient feeding, insufficient chills & riser and gating system being not properly designed by doing systematic analysis and taking necessary corrective remedial action and analysing defect using diagnostic approach the defect can be minimized. [13]
- In this paper using six sigma with Taguchi technique method in shrinkage defect. After improvement by making 50 casting are poured, the shrinkage defect count is only three, and the other faults are similarly minor the faults are regulated and maintained in this control phase using the derived combination values. The rate of rejection obtained was 6% from 12.90%. [17]

CONCLUSION

By using various tool and simulation method, we find the potential failure mode and potential cause for failure of defect. The basis for the conclusion is that the method of FMEA, six sigma, quality control tools, Taguchi technique are risk analysis used for this purpose is an ideal way to approach the whole concept of the production process and the threats to its effective functioning. As this study is merely based on limited literature, we encourage future research to extend our initial survey using more databases and incorporating other references such as book chapters, dissertations, and literature.

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