© 2017 IJSRST | Volume 3 | Issue 7 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Identification and Analysis of Casting Defects

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ABSTRACT

Casting process is the most widely used process in manufacturing industries. Production of casting involves various processes like pattern making, molding, and core making and melting. It is very difficult to produce defect free castings. Systematic analysis and identification of sources of product defects are essential for successful manufacturing. Since the quality of casting parts are mostly influenced by process conditions, how to determine the optimum process condition becomes the key to improving part quality. The industry generally tries to eliminate the defects by trial and error method. This paper describes the identification and analysis of the casting defects. Filling related defects, Shape related defects and Thermal related defects of casting products are discussed in this paper. Defects occurred by various gating system parameters are also be identified. So good gating system reduces the defects.

Keywords: Casting process, Casting defects, Foundry, Product defects, Gating systems

I. INTRODUCTION

The main objective to carry out this research work is to minimize rejection percentage in casting, there are varieties of problems related to product quality in industries. In this project work different casting defects are studied out by various techniques, this study will definitely be helpful in improving the productivity and yield of the casting. Rejections of the casting on the basis of the casting defect should be as minimized. Casting process is also known as process of uncertainty. Even in a completely controlled process, defects in casting are found out which challenges explanation about the cause of casting defects. The complexity of the process is due to the involvement of the various disciplines of science and engineering with casting. The cause of defects is often a combination of several factors rather than a single one. When these various factors are combined, the root cause of a casting defect can actually become a mystery. It is important to correctly identify the defect symptoms prior to assigning the cause to the problem. False remedies not only fail to solve the problem, they can confuse the issues and make it more difficult to cure the defect.

Casting Defects Can be classified as follows

1. Filling related defect
2. Shape related defect
3. Thermal defect
4. Defect by Gating system

• Filling related defects

Blowhole: - Blowhole is a kind of cavities defect, which is also divided into pinhole and subsurface blowhole. Pinhole is very tiny hole. Subsurface blowhole only can be seen after machining. Gases entrapped by solidifying metal on the surface of the casting, which results in a rounded or oval blowhole as a cavity. Frequently associated with slugs or oxides the defects are nearly always located in the cope part of the mould in poorly vented pockets and undercuts.

Sand burning: - Burning-on defect is also called as sand burning, which includes chemical burn-on, and metal penetration. Thin sand crusts firmly adhering to the casting. The defect occurs to a greater extent in the case of thick-walled castings and at high temperatures. The high temperature to which the sand is subjected causes sintering of the betonies and silicate components. In addition, the always present iron oxides combine with the low-melting-point silicates to form iron silicates, thereby further reducing the sinter point of the sand. Sintering and melting of the impurities in the molding sand enable the molten iron to penetrate even faster,

these layers then frequently and firmly adhering to the casting surface.

Cold lap or cold shut: - Cold lap or also called as cold shut. It is a crack with round edges. Cold lap is because of low melting temperature or poor gating system. When the metal is unable to fill the mould cavity completely and thus leaving unfilled portion called misrun. A cold shunt is called when two metal streams do not fuse together properly.

Misrun: - Misrun defect is a kind of incomplete casting defect, which causes the casting uncompleted. The edge of defect is round and smooth. When the metal is unable to fill the mould cavity completely and thus leaving unfilled portion called misrun. A cold shunt is called when two metal streams do not fuse together properly.

Gas porosity: - The gas can be from trapped air, hydrogen dissolved in aluminum alloys, moisture from water based die lubricants or steam from cracked cooling lines. Air is present in the cavity before the shot. It can easily be trapped as the metal starts to fill the cavity. The air is then compressed as more and more metal streams into the cavity and the pressure rises. When the cavity is full it becomes dispersed as small spheres of high pressure air.

Figure 1 : Component with Shrinkage – Porosity defects

• Shape defects

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

Distortion or warp: - Warped Casting—Distortion due to warp age is known as warp defect.

Flash defect: - Flash can be described as any unwanted, excess metal which comes out of the die attached to the cavity or runner. Typically it forms a thin sheet of metal at the parting faces. There are a number of different causes of flash and the amount and severity can vary from a minor inconvenience to a major quality issue. At the very least, flash is waste material, which mainly turns into dross when re-melted, and therefore is a hidden cost to the business.

• Thermal defects

Cracks or tears: - Cracks can appear in die castings from a number of causes. Some cracks are very obvious and can easily be seen with the naked eye. Other cracks are very difficult to see without magnification.

Shrinkage: - Shrinkage defects occur when feed metal is not available to compensate for shrinkage as the metal solidifies. Shrinkage defects can be split into two different types: open shrinkage defects and closed shrinkage defects. Open shrinkage defects are open to the atmosphere, therefore as the shrinkage cavity forms air compensates. Isolated pools of liquid form inside solidified metal, which are called hot spots. The shrinkage defect usually forms at the top of the hot spots. They require a nucleation point, so impurities and dissolved gas can induce closed shrinkage defects. The defects are broken up into macro porosity and micro porosity (or micro shrinkage), where macro porosity can be seen by the naked eye and micro porosity cannot can be seen by the naked eye.

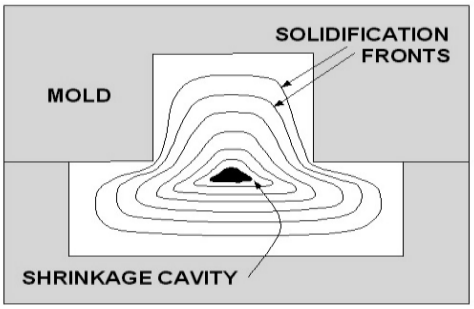

Figure 2 : Solidification Process

Sink mark and void: - Sink marks and voids both result from localized shrinkage of the material at thick sections

without sufficient compensation. Sink marks appear as depressions on the surface of a molded part. These depressions are typically very small; however they are often quite visible, because they reflect light in different directions to the part. The visibility of sink marks is a function of the color of the part as well as its surface texture so depth is only one criterion. Voids are holes enclosed inside a part. These can be a single hole or a group of smaller holes. Voids are caused when the outer skin of the part is stiff enough to resist the shrinkage forces thus preventing a surface depression. Instead, the material core will shrink, creating voids inside the part.

Defect by Gating system:-A proper runner and gating framework are essential to secure quality of casting. With the use of casting simulation technique design of the gating framework of casting defect has been measured. In this manner, the casting simulation technique has become an essential tool for casting defect troubleshooting and optimization method. It helps in enhancing product quality and upgrade the yielding of casting, reduced cost and spare time among other optimization technique.

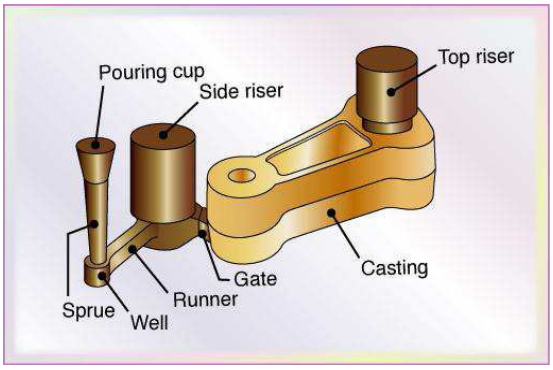

Figure 3: Parts of Typical Gating System

II. LITERATURE REVIEW

1. Sandeep Singh, Lakhwindar Pal Singh & Gurudatt Sahni-, The defect of casting i.e. warpage can be reduced. These will helpful to quality control department of casting industries for analysis of casting defects. Also the casting simulation technology has now days become a beneficial powerful tool for casting defect troubleshot. This will reduce the lead time for the sample casting; improved productivity. In general, warpage can be eliminated by iteratively designing (gating) system and by referring methods which helps in analysis of casting defects may minimizes the rejection of casting.

2. Mr. Siddalingswami. S. Hiremath -The numerical simulation technique was applied to the casting process of a valve type part. The mold filling and solidification stages of the casting were numerically analyzed. The filling behavior, solidification sequence, and thermal stress distribution were reproduced and the possible defects, such as cold shut and shrinkage, were predicted, Based on the simulation result, the double gating system was replaced by a single gating system, Meanwhile, the chill were used to regulate the solidification sequence of casting. To eliminate the cracks in the casting, the sand core was converted into a canulate one. By modifying the original process, the defects were eliminated and the casting with good quality was obtained.

3.A. Rai, S. K. Ganguly Casting products rejection by many defects like hot spot shrinkage Porosity, Gas porosity etc. But among all these defect hot spot defect is responsible for 11 % rejection of casting of Solid Disc. So currently in the casting of brake drum disc, hot spot is occurring at top face. We have reduced this percentage of rejection of casting by reducing the Hot Spot defect. For reducing this hot spot defects there are many ways like changing gating design system, changing metallurgical parameters (by adding inoculants), by using different statistical tools, different software techniques etc. Out of which we have concentrated on the gating design system Casting simulation technology has become an essential tool for casting defect troubleshooting and optimization method. It improves quality product without shop-floor trials.With the use of optimization techniques gating system of the casting are improve and increase the yield percentage of the casting. This would result reduction in cost and material saving. Many design rules, are developed over the years through experience and study. But For wide spread application, simulation programs must be easy to use, fast, and reliable. This can be achieved by integrating method design, solid modeling, and simulation techniques. The Simulation software has proven its reliability and accuracy in predicting internal defects which help to reduced shop floor trials, and optimization using a single software program.

4. Achamyeleh A. Kassie, Samuel B. Assfaw, In this paper, it dealt for obtaining a gating framework design of good quality. A proper runner and gating framework are essential to secure quality of casting. With the use of

casting simulation technique design of the gating framework of casting defect has been measured. In this manner, the casting simulation technique has become an essential tool for casting defect troubleshooting and optimization method. It helps in enhancing product quality and upgrade the yielding of casting, reduced cost and spare time among other optimization technique. Throughout the years, numerous design standards or optimization method has been developed and employed in the casting industry, yet the simulation has wide application among the others. Since simulation is easy to use, fast and having reliable result. It also enable to minimize the value added time in casting development. In the long run, and having the ability to predict the internal defect of casting which helps to reduce the shop floor trials.

5. Shantanu Joshi, Prof. B.R.Jadhav :- Identified the casting engineers decides the casting process, parting line, cores, mould box, feeders, gating system and mould layout, and analyzes each decision to suggest how the design could be modified to improve quality as well as reduce tooling and manufacturing costs. Hence casting solidification simulation enables predicting and preventing potential problems before freezing the product design, determining 'goodfirst' methoding solutions to achieve high yield at the desired quality level, and evolving optimal process plans compatible with both product requirements and foundry capability. In this study, it was observed that solidification simulation enables visualization of the progress of freezing inside a casting and identification of the last freezing regions or hot spots. Placement of the feeder at the last solidifying regions did not shift the hot spot completely into the feeder. Hence, an exothermic sleeve was attached to the feeder, which has completely shifted the hot spot in the feeder and there by eliminated shrinkage defect problem.

III. CONCLUSION

Casting defects are very serious for the industry .These defects can be minimised.In order to determine the parameter that affects the formation of defects in casting, a number of descussions were made for this causes.In this paper the different reviews of researchers have dicussed regurding the casting defects identification

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