Casting Defect Analysis in Diverter Wheel and Preventive for Quality Improvement of Casting-Review

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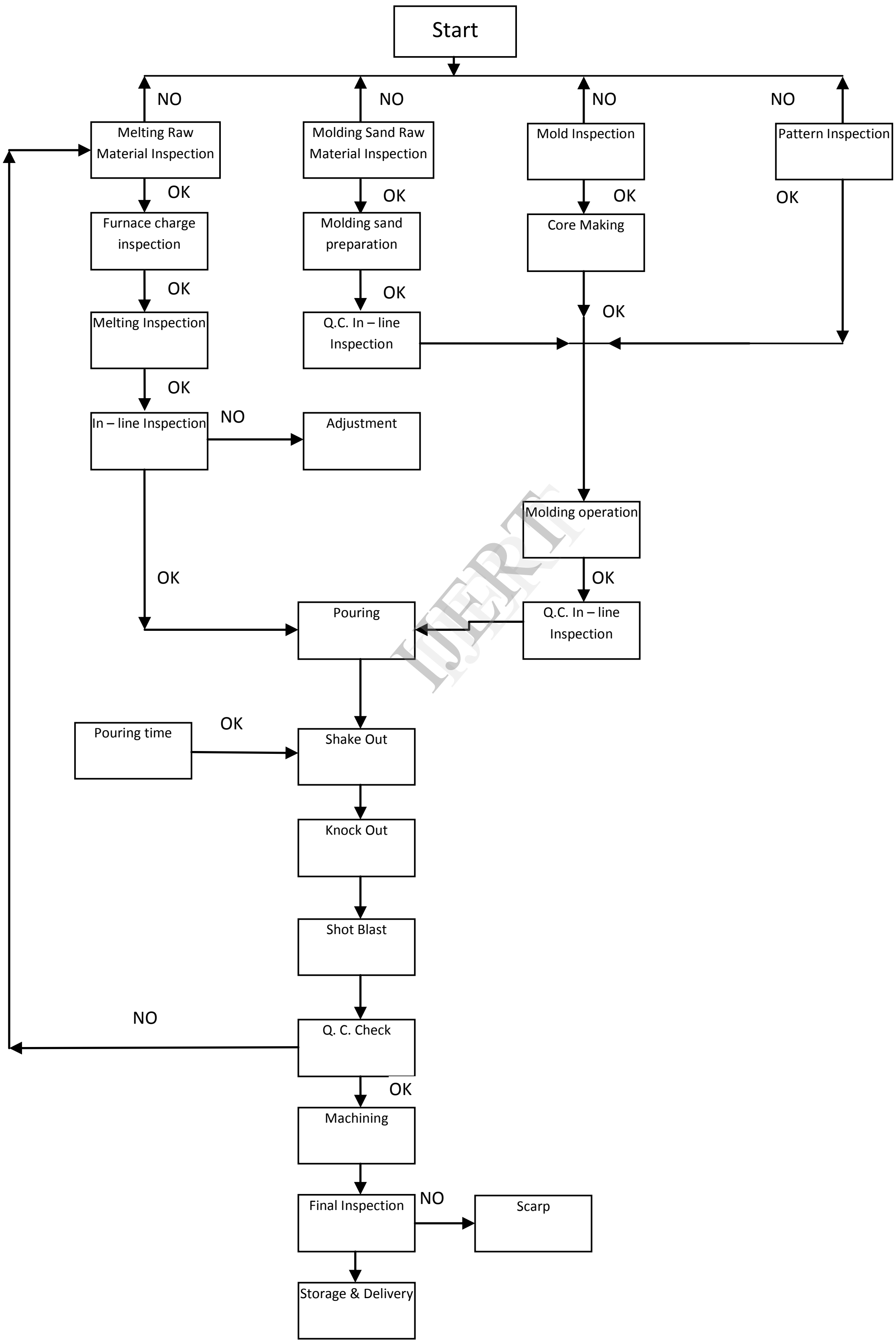
Abstract — *Casting is very difficult production processes carries risk of failures occurrence during all the process of execution of the finished products. The control of casting defects is a major problem for most small foundries where a variety of problems can occur. It's very important to have an opposite process assessment, to perform preventive activities, and to make use of research techniques for better loss prevention. The first step is to properly identify the casting defect and then to classify the defect according to a casting defect classification system. Casting production involves various processes which include pattern making, molding, core making, melting pouring, shell breaking, shot blasting etc. It is almost impossible to produce defect free castings. Occurrence of the defect may involve single or multiple causes. These causes can be minimized through systematic procedure. This paper deals with casting defects in Diverter Wheel. A Diverter wheel is a part used in lift on which metal cable is wound to give up and down movement to the lift.*

Keywords — Castings, Casting Defect, Blow holes, Pinholes, Short pouring, Mismatch, Shrinkage.

Introduction — Casting is the process is most valuable process and is used to produced part in Mining, Mineral processing, Core sector, Chemical, Machine Tool, Transport and Textiles. One of the most competitive processes for economical and large scale production. Advancement of materials and metallurgical sciences as applicable to the casting industry have made it possible to obtain high rate of production within desired dimensional tolerances and surface finish of small intricate shaped objects with required metallic properties optimized by the addition of alloying elements to modify its chemical composition. There are many casting processes available. The best one selected depends on several basic factors, such as cost, size, production rate, surface finish, tolerance limitations, intricate shape, mechanical properties, machinability and weldability. Foundries have inspection equipment can detect wide variety of external and even internal defects. There are so many variables in the production of a metal casting that the cause is often a combination of several factors rather than a single one. All pertinent data related to the production of the casting sand and core properties, pouring temperature, Material properties must be known in order to identify the defect correctly. After the defect is identified an attempt to eliminate the defect by taking appropriate corrective action is necessary for quality enhancement.

Flow Process Chart For Diverter Wheel Casting



Various Defect In Diverter Wheel Casting

Any unwanted deviation from the desired requirements in a cast product results in a defect. Some defects in the cast products are tolerable while others can be rectified by additional processes like welding etc. The following are the major defects which are likely to occur in sand castings:

A. Gas defects
B. Shrinkage cavities
C. Molding material defects
D. Pouring metal defects
E. Metallurgical defects

A. Gas Defect

1. **Blow holes and Open blows:** These are spherical, flattened or elongated cavities present inside the casting or on the surface. When present inside the casting it is called blow hole while it is termed as open blow if it appears on the surface of the casting. These defects are caused by the moisture left in the mould and the core. Due to heat of the molten metal the moisture is converted into steam, part of which when entrapped in the casting ends up as blow hole or ends up as open blow when it reaches the surface. Thus in green sand mould it is very difficult to get rid of the blow holes, unless properly vented.

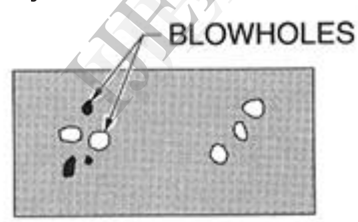


Fig. 1.1

Causes:

1. Excessive moisture in the molding sand.
2. Low permeability and excessive fine grain sands.
3. Cores neither properly baked not adequately vented.
4. Extra hard rammed sand.
5. Rusted and dam chills, chaplets and inserts.
6. Excessive use of organic binders.

Remedies Measure:

1.Control moisture content.
2. Use clean and rust free Chills, chaplets and metal insert.
3. Bake cores property.
4. Proper use of organic binders.
5. Cores and moulds should be property vented.
6. Moulds should not be rammed excessively hard.

2. **Pin hole porosity**: As the molten metal gets solidified it loses the temperature which decreases the solubility of gases and thereby expelling the dissolved gases. The hydrogen which is picked up by the molten metal either in the furnace from the unburnt fuel or by the dissociation of water inside the mould cavity may escape the solidifying metal leaving behind very small diameter and long pin holes showing the path of escape. The high pouring temperature which increases the gas pick up is the main reason for this defect.

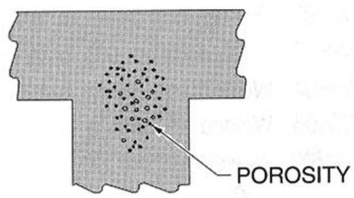


Fig. 1.2

Causes:

1. High pouring temperature.
2. Gas dissolved in metal charge.
3. Less flux used.
4. Molten metal not properly degassed.
5. Slow solidification of casting.
6. High moisture and low permeability in mold.

Remedial Measures:

1. Vacuum melting
2. Vacuum degassing
3. Avoiding very high pouring temperature.

B. Shrinkage Cavity

3. **Shrinkage Cavity**: Shrinkage faults are faults caused by improper directional solidifications, poor gating and rising design and inadequate feeding. Solidification leads to volumetric contraction which must be compensated by feeding. If this compensation is inadequate either surface shrinkage or internal shrinkage defects are produced making the casting weaker.

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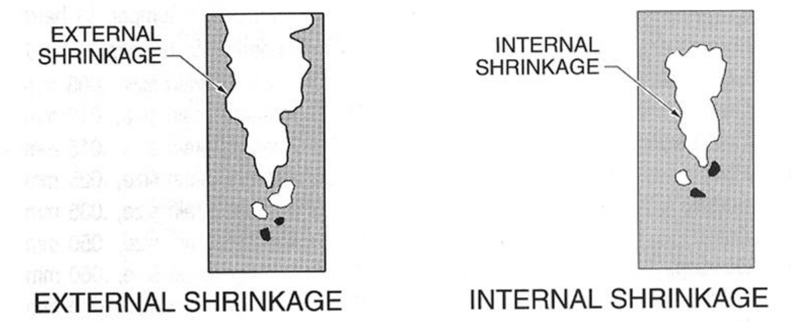

Fig. 1.3

Causes:

1. Faulty gating and risering system.
2. Improper chilling.

Remedial Measures:

1. Ensure proper directional solidification by modifying gating, risering and chilling.

D. Molding Material Defects

4. Mismatch: A misalignment between two halves of a mould or of a core may give rise to a defective casting.

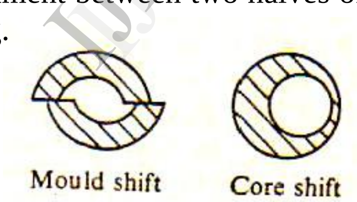

Fig. 1.4

Causes:

1. Misalignment
2. Worn out clamping pins.
3. Improper support and incorrect location.
4. Faulty core boxes.

Remedies:

1. Repair and replace the pins.
2. Provide adequate support to core.

5. Scabbing: This refers to the rough thin layer of a metal, protruding above the casting surface, on top of a thin layer of sand. The layer is held onto the casting by a metal stringer through the sand. A scab results when the upheaved sand is separated from the mould surface and the liquid metal flows into the space between the mould and the displaced sand.

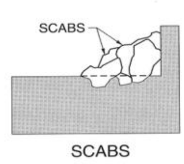

Fig. 1.5

Causes:

1. Continuous large flat surfaces on casting.
2. Excessive mold hardness.
3. Lack of combustible additives in molding sand.

Remedies:

1. Break continuity of large flat groves and depressions
2. Reduce mold hardness.
3. Add combustible additives to sand.

6. **Sand Drop**: An irregularly shaped projection on the cope surface of a casting is called a drop. This is caused by dropping of sand from the cope or other overhanging projections into the mould. An adequate strength of the sand and the use of gaggers can help in avoiding the drops.

Fig. 1.6

Causes:

1. Low green strength in molding sand and core.
2. Too soft ramming.
3. Inadequate reinforcement of sand and core projections

Remedies:

1. Increase green strength of sand mold.
2. Provide harder ramming.
3. Provide adequate reinforcement to sand projections and cope by using nails and gaggers.

E. Pouring Metal Defects

7. **Sand inclusions:** Sand inclusion is one of the most frequent causes of casting

rejection It is often difficult to diagnose, as these defects generally occur at widely varying positions and are therefore very difficult to attribute to a local cause. Areas of sand are often torn away by the metal stream and then float to the surface of the casting because they cannot be wetted by the molten metal. Sand inclusions frequently appear in association with CO blowholes and slag particles. Sand inclusions can also be trapped under the casting surface in combination with metal oxides and slags, and only become visible during machining. If a loose section of sand is washed away from one part of the mould, metallic protuberances will occur here and have to be removed.

Causes :

1. Faulty gating.
2. Faulty pouring.
3. Inferior molding or core sand.
4. Soft ramming of mold.
5. Rough handling of mold and core.

Remedies:

1. Modify gating system
2. Improve pouring to minimize turbulence.
3. Use of superior sand of good strength.
4. Provide hard, ramming.

8. Slag inclusions: During the melting process, flux is added to remove the undesirable oxides and impurities (refractory materials, sand) present in the metal. At the time of tapping, the slag should be properly removed from the ladle, before the metal is poured into the mould. Otherwise any slag entering the mould cavity will be weakening the casting and also spoiling the surface of the casting.

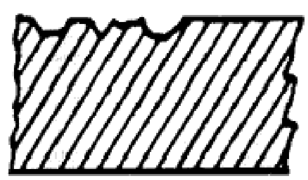

Fig. 1.7

Causes :

1. Faulty gating.
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4. Soft ramming of mold.
5. Rough handling of mold and core.

Remedies:

1. Modify gating system
2. Improve pouring to minimize turbulence.
3. Use of superior sand of good strength.
4. Provide hard, ramming.

9. **Cold shut:** For a casting with gates at its two sides, the misrun may show up at the centre of the casting due to non fusion of two streams of metal resulting in a discontinuity or weak spot in casting. Above two defects are due to lower fluidity of the molten metal or small thickness of the casting. The fluidity of the metal can be increased by changing the composition of molten metal or raising the pouring temperature. The other causes for these defects are large surface area to volume ratio of the casting, high heat transfer rate of the mould material and back pressure of the gases entrapped in the mould cavity due to inadequate venting.

Cold shut

Figure 1.s8

Causes:

1. Lack of fluidity in molten metal.
2. Faulty design.
3. Faulty gating.

Remedies:

1. Adjust proper pouring temperature.
2. Modify design.
3. Modify gating system

10. **Poured short:** The upper portion of the casting is missing. The edges adjacent to the missing section are slightly rounded; all other contours conform to the pattern. The spree, risers and lateral vents are filled only to the same height above the parting line, as is the casting (contrary to what is observed in the case of defect).

Causes:

1. Insufficient quantity of liquid metal in the ladle;
2. Premature interruption of pouring due to workman's error.

Remedies:

1. Have sufficient metal in the ladle to fill the mold;
2. Check the gating system;
3. Instruct pouring crew and supervise pouring practice.

R EVIEW OF WORK CARRIED OUT

Si-Young Kwak1, Jie Cheng, [1] Shrinkage cavity may be detrimental to mechanical performances of casting parts. In this paper, process of Al alloy wheel impact test was computationally analyzed for both the wheel models with and without shrinkage cavity defects. After the impact simulation was conducted, the results show that under impact test condition, the wheel considering shrinkage cavity defects may fracture while the sound-assumed wheel may not. For impact test analysis of casting Al wheel, the proposed analysis results show that the shrinkage cavity located in high strained area of casting part may be far more detrimental than in low strained area. In conclusion, the proposed approach can reflect strain concentration effect and improve the accuracy of simulation with proper computational cost.

L.A. Dobrzanski, M. Krupinski [4] this publication is to present the methodology of the automatic supervision and control of the technological process of manufacturing the elements from aluminum alloys and of the methodology of the automatic quality assessment of these elements basing on analysis of images obtained with the X-ray defect detection, employing the artificial intelligence tools. The methodologies developed will make identification and classification of defects possible and the appropriate process control will make it possible to reduce them and to eliminate them - at least in part. The developed computer system, in which the neural networks as well as the method of automatic image analysis were used, can ensure the automatic identification and classification of defects incasing, to eliminate them - at least in part.

Malcolm Blair, and Raymond Monroe [5] Casting designs are generally based on strength of materials calculations and the experience of the designer. Designs utilizing factors of safety, which lead to increased component weights and in efficient use of materials recent work to predict the occurrence and nature of defects in castings and determine their effect on performance. The need to design and produce lighter weight and higher-performing castings will continue to increase in the future. This paper is to develop computer simulation methodologies to predict the performance of cast parts. The resulting designs should be less expensive to develop, requiring less time, testing, and design iteration.

A. P. More, Dr. R .N. Baxi and Dr. S. B. Jaju [6**]** Modern method of designing the cast component using various software and simulation technique is really a boon for the industrial sector. It offers number of advantages and in the form of intelligent tool to enhance the quality of cast component. These will definitely helpful in improving the productivity and yield of the casting .Rejection of the casting on the basis of the casting defect should be as minimum as possible and all the above research is heading in the same direction.

K. SIEKANSKI, S. BORKOWSKI [7] In the article is presented an example of foundry production, an usage of quality control tools. This was the point for good conclusions in relating to qualitative activity of analyzed firm. Passed at usage of selected methods of researches it gives base to introductions of correctness in casting process. Efficiency of usage of improvement methods in of quality of casting process perfectly is perfectly visible on represented examples. Usage of Ishikawa diagram permitted to identify areas especially subjected to risk of failures formation. Ishikawa's diagram represents in a complex manner factors, which are responsible for examined problems - large quantity of defects are caused by material and defaults of employees and technology. Pareto diagram directs to irrevocable separation of main nonconformance: displacement, misrun, slaggy, in homogeneity, shrinkage depression, hot crack On the base of this diagram a conclusion was formulated, that the quantity of nonconformance in production process is influenced mainly by behavior of employees connected with negligence, noncompliance of technological process recommendations, of procedure etc.

Prof B. R. Jadhav, Santosh J. Jadhav [8] The correct identification of the casting defect at the initial stage is essential for taking remedial actions .This paper presents the systematic approach to find the root cause of one of the major defect (Cold shut) in an automobile casting produced in a medium scale foundry. The origin of the Cold shut defect was identified by means of Seven Quality control tools. Finally, it was found that the alloy composition and pouring temperature was the root cause for this major defect. The necessary remedial action was made in production of Cylinder block. The major Cold shut defect was reduced by up to 50%. The from cold shut was reduced to 6.6 This systematic study proves that by means of effective analysis of tools and processes, it is possible to eliminate/control the casting defect.

Conclusion: The identification of the casting defect at the primary stage is important for taking corrective actions. Therefore it is very necessary to use of the modern methodology to improve or remove the casting defect. Modern method of design the cast part using different software and simulation method is really a advantage for the casting industries. It offers number of benefits and in the form of intelligent tool to improve the quality of cast part. It will positively helpful in improving the productivity and yield of the casting .Rejection of the casting on the basis of the casting defect should be as very low as possible and all the above study is move forward in the same direction.

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