

A Review on Investigation of Casting Defects with Computer Aided Simulation

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Abstract— The objective of this paper is investigate casting defects and provide remedies and computer aided simulation of casting process by using computer aided simulation software. The casting may have one or more defects. Foundries is still using trial and error methods to solve problems. Casting defect occurs due to improper feeding system. Computer aided simulation is useful in minimizing the casting defects. In computer aided simulation Autocast-X Procast and Solid cast software's can be used. This paper also aims to provide correct guideline to find casting defects as well as finding different defects in casting, analysis of defects and providing their remedies with their causes.

Key words: Casting, Casting Defects, Remedies, Computer Aided Simulation

- Pour molten metal into mold
- Remove solidified object form mold
- Polish and finish final product

B. Casting Terms

- Flask: A metal or wood frame.
- Pattern: It is replica of the final object.
- Cope: Upper flask
- Drag: Lower flask
- Pouring basin: Small semicircular hole at top for filling molten metal.
- Sprue: pathway for molten metal
- Runner: The channel through which the molten metal is carried from the sprue to the gate.
- Gate: A channel through which the molten metal enters the mold cavity.
- Riser: A column of molten metal placed in the mold .it also help to flow metal back words.
- Chill: Metallic chills used for desired cooling rate.

I. INTRODUCTION

A. Sand Casting

Sand casting also known as molded casting. In metal casting process sand as the mold material. Casting is a process of making solid objects by pouring molten metal into cavity.

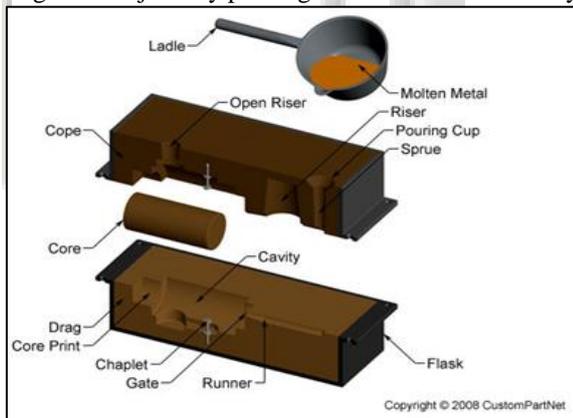


Fig. 1: Sand-Mould Open

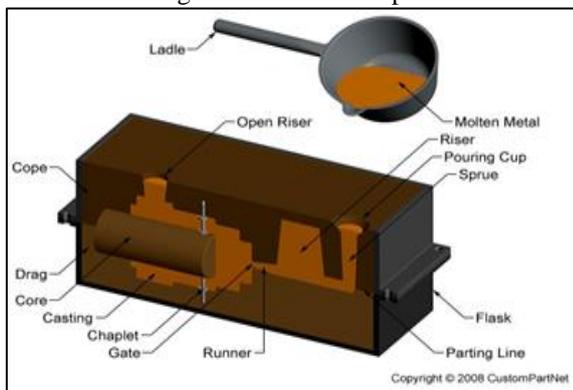


Fig. 2: Sand Mould Close

Casting involves following steps:

- Create a mold
- Prepare the mold

Most of parts are manufactured by casting process. Casting inspection are basically classified as destructive and non destructive tests (NDT). Well-designed feeding system reduces the casting defects. Quality of product is depends upon the quantity risers and location of runners and risers. Making changes in the feeding system and relocating the position of risers manually is time taking hence simulation is important for the improve the feeding system which will help to improve the quality product.

C. Casting Defects

1) Shrinkage Defect:

This defects occurs due to insufficient feed metal for solidification .Shrinkage defect can be divided in to two types 1) open shrinkage 2) closed shrinkage defects.



Fig. 3: Shrinkage Cavity Defect

Causes:

- Pouring temperature
- Non uniform solidification
- Extreme release of gas

Remedies:

- Improve gating system
- Proper location of riser

- Providing proper venting

2) *Misrun:*

Incomplete cavity is known as misrun. When molten metal does not fill the cavity completely.



Fig. 4: Misrun Defect

Causes:

- Incomplete casting
- Poor gating system

Remedies:

- Modification in gating system
- Improve the feeding system

3) *Blow whole Defect:*

It is large cavity formed due to gases inside the molten metal.



Fig. 5: Blowhole Defect

Causes:

- Entrapment of gases
- Low permeability
- Moisture absorbed by cores

Remedies:

- Use of dry chills
- Improve gating arrangement

4) *Mismatch Defect:*

Mismatch is mold defect is because of the shifting molding flasher. It will causes the dislocation at the parting line.



Fig. 6: Mismatch Mold Defect

Causes:

- Improper position of cope and drag

- Dislocation at parting line

Remedies:

- Improve position of cope and drag
- Using proper molding and pins

Cracks:

Crack defects normally happen inside of metal casting. This defects occurs due to number of reason.

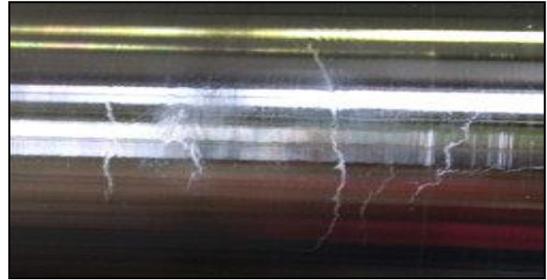


Fig. 7: Crack Defect

Causes:

- Internal stresses
- Damage in cavities

Remedies:

- Use of chills
- Avoid superheating

5) *Sand Inclusion:*

It is also known as sand hole. It is the sand remained in the casting after solidification



Fig. 8: Sand Inclusion Defect

Causes:

- Irregular mold
- Low compact ability

II. SIMULATION

In today's manufacturing environment casting process simulation is the imperative tool allows foundries to obtain reliable and high quality cast parts. Simulation software we provide cutting edge solutions that meet the needs of casting produces. Casting simulation is the standard accepted for designing the casting process before producing expensive mould or patterns. Simulation requires very less input data and gives good results. Separate design software is necessary to make CAD model as an input to simulation software. Simulation software's accessible in India like ProCast, SolidCast AutoCAST-X and MAGMA.

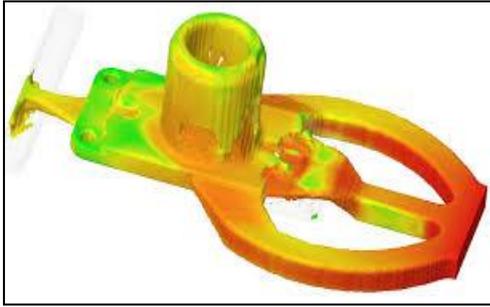


Fig. 9: Simulation

Benefits of casting simulation

- Energy saving
- Improved product quality
- Less remelting and refinishing
- Shortened lead time and increased production
- First time right

It includes following steps:

- Data gathering
- Part modeling
- Gating system design
- Simulation
- Optimization
- Report generation

III. LITERATURE REVIEW

This includes brief information about the work done by various authors in reducing the casting defects. Author has worked on examination of irregularity in casting and remedies are provided to get zero defect casting. Study reveals that rejected casting include sand drop, blowhole, and mismatch defect. [1] Special systems are used for processes that are influenced by multiple events to take decisions. Special systems are innovated on fuzzy method to detect the incidence of foremost casting defects. Study concentrates on sand casting of gray iron. Developed systems help the foundry engineers to take decisions regarding sand casting to avoid irregularities. Remedies are provided helpful for less defect casting [2] In this review several casting defects and their occurrence cause were identified. Study is helpful in examining the defects and application of remedies. Casting defects should be less to avoid rejection. One can continuously control rejections by taking in to consideration different parameters at every stage of production. Thus it is indispensable for a foundry expert to have awareness on the identification of type of defect and to identify the exact root cause, and their remedies. Hence this systematic work will be fruitful for quality casting manufacturing. [3] Author has worked on finding defects in casting process. The full picture for existence of contraction defects is provided and solution is provided. By appropriate casting method developing feeding system, appropriate position of in gates and feeders will lessens the contraction defect. Soft cast software is recommended for simulation of casting. [4] Author provides an intense knowledge of critical defects and their root cause analysis. This paper emphasizes on technically viable solutions for decreasing several defects and enhancing the superiority of castings which will be guidelines for foundry engineers.[5] Study of influencing

factors for blowholes in die casting is essential. Aluminum Parts of compressor are studied. Various factors like pressure, pouring speed, starting position and void pressure are examined. Paper focus is on blowhole reduction by considering venting system also. [6] Surface analysis of discontinuities produced in castings is effective for evaluation of castings irregularities and implementing preventive measures. . [7] Most work is done on irregularity diminution in casting. Author has explained various methods for defect analysis which are FEM, modulus method, solidification simulation using FEM and dedicated software for simulation such as Procast, AutoCast-X. [8] Agenda of work is to probe the probable sources of gases like nitrogen, hydrogen and oxygen, concentrating on making practice that is in contact with the liquid steel. Disadvantages of chemical and gas content are examined. Also gas removing capability of casting should be increase Remedies are provided helpful for less defect casting.[9] In this review, work is done on a wear plate. Existing feeding system is studied and imitation of new feeding system is done by using AutoCast software. During casting gates and riser were placed symmetrically and flow was uniform, gases were easily escaped to the atmosphere. By using this method superiority of casting has been improved. [10]

IV. CONCLUSION

Defects like shrinkage, misrun, blow whole, mismatch, sand inclusion can be identified and simulated. Separate design software is used for simulation. Simulation helps to manufacture defect free casting without consuming too much time. In India, casting simulation technology is increasing rapidly. This technology can also be used for development of new products

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