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A Critical Review on Casting Types and Defects

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ABSTRACT

Casting is the oldest manufacturing method and well known metallurgical process. Casting process basically involves introduction of molten metal into a mold cavity and subsequently the molten metal takes the shape of mold cavity. Very simple and high end complicated shapes and designs can be made from any metal that can be melted. Casting is an integrated process which is considered as an experienced artful work with high end quality aspects. Even though these high quality aspects are considered, defects are very much inherent in casting process. The main objective of the current review is to explain casting types and discuss the possible defects during the process of casting. The scope of the review also includes causes and remedies of casting defects.

Keywords: Casting types, Types of sands, casting defects, remedies.

I. INTRODUCTION

In developing countries, many industries face problems with poor quality aspects and productivity in manufacturing techniques of process parameters. Even though considering much care in each and every step, the imperfections and causes are seen in casting process. Beside this, finding various types of methods to overcome the different causes and defects is seen in the process. To obtain the good source of knowledge about casting, there failures, causes and cure measurements should be analysed and care is to be taken in casting enhancements [1].

II. METHODS AND MATERIAL

2. CASTING

Casting is the foremost process in which broadly used methods for fabrication of metallic refurbishments outside the mouth. The technique of conducting casting is one of the oldest and most advanced of the metallurgical arts. The basic principle lying in casting is 'liquid observes to the shape of the vessel that clings it'. The process consists of surrounding the wax pattern with a mould made of heat resistant investment material, eradicating the wax by heating and introducing the molten metal into the mould through a channel called "SPRUE". So during the process of casting there are chances of occurring defects. Minor defects can be managed but causing of occurring major defects can lead to more investment costs.

2.1 TYPES OF CASTING

- Sand castings
- Die castings
- Investment castings
- Permanent castings
- Centrifugal castings.

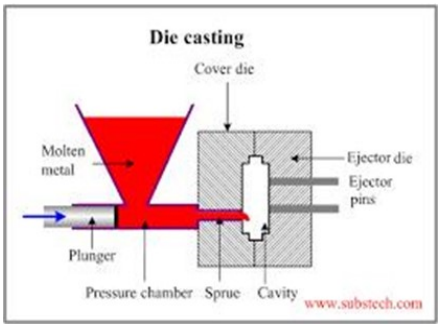
2.1.1 SAND CASTING:

Sand casting is often utilised in industries For Instance: automotive, aerospace and design industries etc... To make parts of comprised of Iron, bronze, brass and aluminium. The metal of require is gets melted in a furnace at desired temperatures and poured into a mould cavity formed out of sand. This process is preferred because of inexpensive and relatively free of cost.

However, flaws are very common in sand cast parts and these affects the properties of castings.

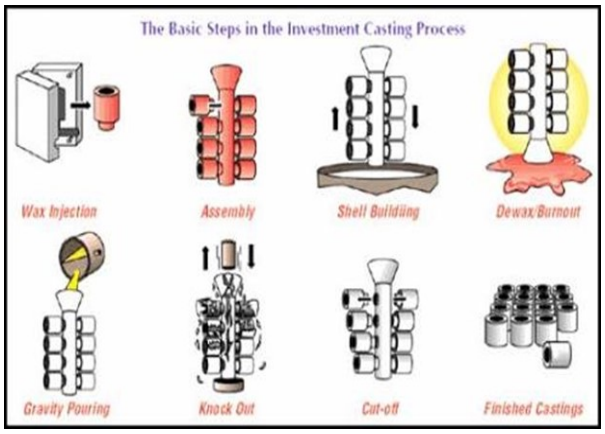
2.1.2 DIE CASTING

Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity. The mold cavity is created using two hardened tool steel dies which have been machined into shape and work similarly to an injection mould during the process. The casting equipment and the metal dies represent large capital costs and this tends to limit the process to high-volume production. Manufacture of parts using die casting is relatively simple.



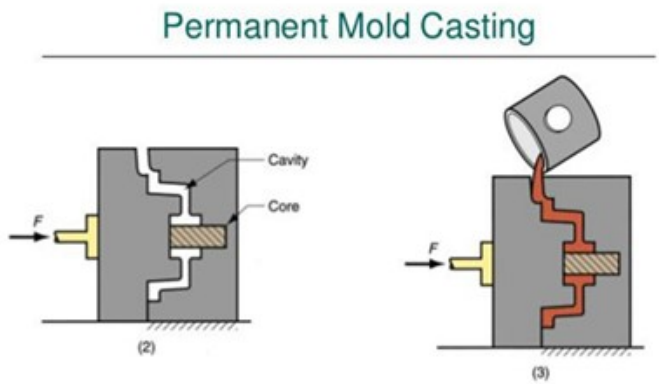
2.1.3 INVESTMENT CASTING

Investment casting is a manufacturing process in which a wax pattern is coated with a refractory ceramic material. Once the ceramic material is hardened its internal geometry takes the shape of the casting. The wax is melted out and molten metal is poured into the cavity where the wax pattern was. The metal solidifies within the ceramic mould and the metal casting is broken out.



2.1.4 PERMANENT CASTING

Permanent mould casting is a metal casting process that employs reusable moulds ("permanent moulds"), usually made from metal. The most common process uses gravity to fill the mould, however gas pressure or a vacuum are also used. A variation on the typical gravity casting process, called slush casting, produces hollow castings. Common casting metals are aluminium, magnesium, and copper alloys. Other materials include tin, zinc, and lead alloys and iron and steel are also cast in graphite moulds.

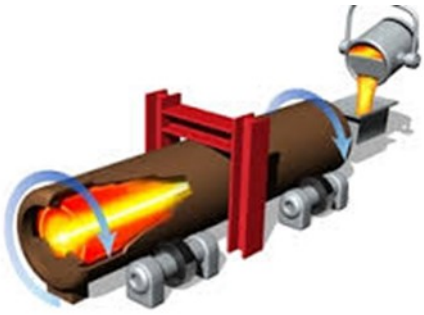


Steps in permanent mold casting: (2) cores (if used) are inserted and mold is closed, (3) molten metal is poured into the mold, where it solidifies.

2.1.5 CENTRIFUGAL CASTING

Centrifugal casting or rotocasting is a casting technique that is typically used to cast thin-walled cylinders. It is used to cast such materials as metal, glass, and concrete. It is noted for the high quality of the results attainable, particularly for precise control of their metallurgy and crystal structure. In the centrifugal casting process, molten metal is poured into a spinning die. The die can be spinning either on a vertical or horizontal axis depending on the configuration of the desired part. Ring

and cylinder type shapes are cast vertically; tubular shapes are made with the horizontal centrifugal process. Either process may be used to produce multiple parts from a single casting. External structures and shaping can be cast in place to significantly reduce post-processing including machining or fabrication.



2.2 Types of Moulding Sands

- Greensand-It is aggregate of sand, bentonite clay, pulverized coal and water. The clay contain of green sand of 30% and water 8%.Clay and water are used for binding strength of sand. This sand is mostly used for ferrous and non-ferrous material. It is fine, soft and has good porosity.
- Dry sand-If the sand mould id baked in an oven, the moisture of this mould will be evaporated. This sand is called as dry sand. It possess major strength and used for large moulding.
- Loam sand-Loam sand is mixture of sand and clay with water. It contains 50% and 18% clay and water respectively. This is used for larger casting.
- Facing sand-The face of the mould is formed by facing sand. Facing sand is used directly next to the surface of the pattern and it comes in direct contact with the molten metal, when the molten metal is poured into the mould. It possesses high strength and refractoriness as it comes in contact with the molten metal. It is made of clay and silica sand without addition of any used sand.
- Backing Sand-Backing sand or flour sand is used to back up facing sand. Old and repeatedly used moulding sand is used for the backing purpose. It is also sometimes called black sand because of the addition of coal dust and burning when it comes in contact with the molten metal.
- Core sand-The sand which is used to make core is called core sand. It is also called as oil sand. It is a mixture of silica sand and core oil. Core oil is mixture of linseed oil, resin, light mineral oil and other binding materials.

III. RESULTS AND DISCUSSION

3. DEFECTS OF CASTINGS

The undesired irregularity in a metal casting process is called casting defect. Some defects are eliminated and some are repaired.

The three general origins of defects are:

- Casting design
- Technique of manufacture or the method
- Application of technique- workmanship

CATEGORIES OF DEFECTS

- Shaping faults in pouring
- Inclusions and sand defects
- Gas defects
- Shrinkage defects
- Contraction defects
- Dimensional defects
- Compositional errors
- Segregation

The major casting defects are classified as:

3.1 BLOWHOLES

Blowholes are one of the major casting failures caused due to increase and complexity of gases during casting process. The layer wise filling of mould cavity is replicated, accompanied by calculation and display of instantaneous temperature of metal and gas pressure created in the mould cavity. There are various types of defects created in sand casting. A high content of casting defects are caused due to emitting of gases. One of the major casting defects caused due to gases is holes (gas holes). Gas holes are pinholes and blowhole. The blowholes are smooth cavities, spherical, and not touching the external casting surface. [2]

CAUSES

There are various causes of blowhole formation, depending on the evolution of different types of gases and various reactions taking place during mould filling phenomenon. Various causes of the blowhole formation are explained

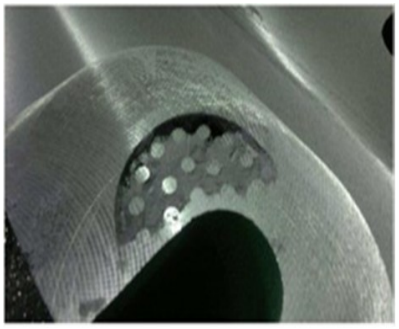
- This defect is caused by great extent of little gas passing tendency in the mould.
- And the improper design of the casting results in imperfection.
- The Excess amount of fine grains present in the sands creates the impact of blowholes.
- Low permeability rate present can also leads to defects.
- Extra hard beating sand.
- Extra use of organic binders
- The Improper way of mixing sand also makes the casting failure with gaps.
- The higher Turbulence during filling and lower flow temperature

REMEDIES

- Controlling the moisture percent correctly and beating the sand slowly.
- Use of rust free chills, chaplet and clean inserts.
- Baking the cores properly and maintaining the percentage of Aluminium.
- Providing adequate venting and cores in mould.
- Acquired pouring temperature must be considered.

3.2 SHRINKAGE

Shrinkage is a type of a casting defect with an irregularity in a metal casting process and due to lack of design and insufficient feed metal. Some defects can be accepted while others can be corrected, otherwise they must be demolished. Shrinkage defects are two types, they are: open shrinkage defects and closed shrinkage defects. Open shrinkage defects are open to the atmosphere; there are two types of open air defects: pipes and caved surfaces. Pipes form at the surface of the casting and burrow into the casting, while caved surfaces are shallow cavities that form across the surface of the casting. Closed shrinkage defects, also known as shrinkage porosity, are defects that form within the casting. [3]



CAUSES

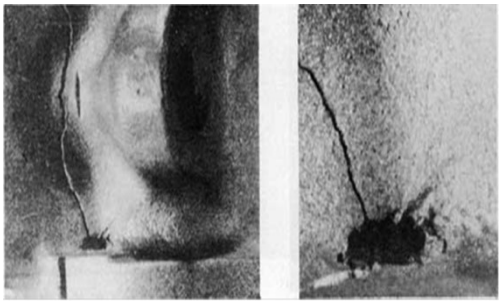
- Flaw gating and disturbances in chilling method.
- At mid-point of casting the shrinkage can ends up with the smaller void sections called as ‘shrinkage porosity’.
- Partially dried sand with lower amount of compressive strength and sudden changes in thickness.
- Possessing sharp edges.

REMEDIAL MEASURES

- Ensure proper directional solidification by modifying gating, and chilling.

3.3 HOT TEARS/CRACKS

These defects can be caused in the weaker part of sections and in cold dies, low metal temperature, dirty metal, lack of venting, other possible defects are gas porosity, shrinkage porosity, weaker sections and flow marks [4].



CAUSES

- Depletion of collapse of core and poor design structure.
- Lack of collapsibility of mould and rough handlings.
- Using heavy force during the ramming.
- Disturbances in the mould and sudden jerks.
- Low range of eutectic cells at grain boundary and improper pointing of riser location.

REMEDIES

- Improving collapsibility of core and mould.
- Modify casting designing and using of fine sand grains.
- Avoiding sharp turns and corners is also a good kind of Remedy.

3.4 SAND INCLUSION

Sand Inclusion is most common casting defects which is nothing but cracks of sand while preparing mould section manifests itself near casting edges to create such failure. Sand inclusion and slag inclusion are also called as scab or blacking scab. They are inclusion defects looks like there are slags inside of metal castings. Irregularities formed in sand inclusions, close to the casting surface. [5]

CAUSES

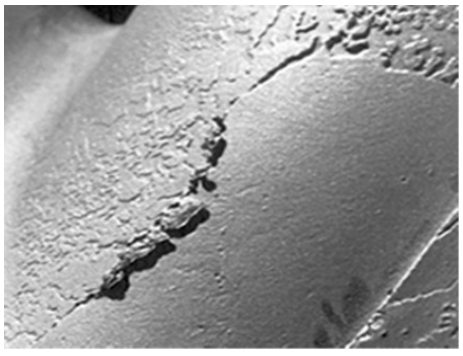
- Crossing of metal stream directly to cores and improper casting and mould design aspects.
- Breakage of mould during alignment and improper way of sand mixing.
- Improper pouring practices causes to mould disturbances [6].

REMEDIES

- Optimal range of pouring height and proper pouring time should be maintained in order to overcome the remedial measurements.
- Using proper cores with correct arrangements.
- Proper mixing ratio with often cleaning of mould cases.

3.5 DEFECTIVE SURFACE

Line formation due to molten metal flow forming in a pattern of line based structures which appear in channels called as defective surface.



CAUSES

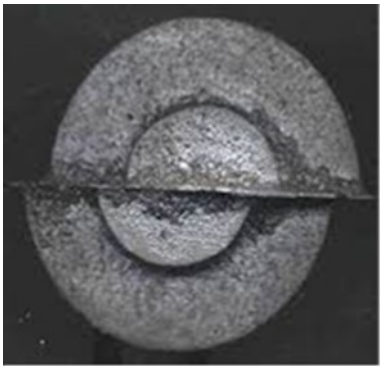
- The higher slag content creates the major defect in defective surface.
- Possessing low temperature of mould and tiny particles on surface of mould.
- Other impurities flowing on surface of casting during preparation.

REMEDIES

- Preheating of mould should be taken before using it and the pouring temperature must be low.

3.6 MISMATCH

Mismatch in mould defect which can be mainly seen because of the changing moulding flashes. It will cause the dislocation at the parting line [7].



CAUSES

- A mismatch is caused by the cope and drag parts of the mould not remaining in their proper position
- This is caused by loosely arranged pins, inaccurate pattern dowel pins or carelessness in placing the cope on the drag.

REMEDIES

- Check pattern mounting on match plate and Rectify, correct dowels.
- Use proper moulding box and closing pins.

IV. CONCLUSION

Different types of possible defects on the work piece during casting have been reviewed. To control these defects, different remedies and causes are discussed. This study is useful for industries where casting is undertaken as a manufacturing process. This entire

study is to minimize the casting defects and increase the standard of casting process.

V. REFERENCES

[1] Sunil Chaudhari and Hemant Thakkar Review on Analysis of Foundry Defects for Quality Improvement of Sand Casting International Journal of Engineering Research and Applications Vol. 4 Issue 3 (March 2014).

[2] Avinash Juriani,"Casting defects Analysis in Foundary and there remedial measures with industrial case studies",IOSR Journal of Mechanical and Civil engineering(IOSR-JMCE),Volume 12, Issue 6,Dec 12.

[3] Rajesh Rajkolhe, J. G. Khan, Defects, Causes and Their Remedies in Casting Process: a review, International Journal of Research in Advent Technology, Vol.2, No.3, 2014.

[4] Bhusan Shankar kamble,"Analysis of Different Sand Casting Defects in a Medium Scale Foundry Industry "International Journal of Innovative Research in Science Engineering and Technology, Volume 5,Issue 2,February 2016.

[5] Achamyeleh A. Kassie and Samuel B. Assfaw Minimization of Casting Defects IOSR Journal of Engineering Vol. 3, Issue 5, May 2013

[6] Mrs.V.S.Deshmukh, The Critical Casting Defect in cast iron: sand inclusion – A Review, International Journal of Mechanical Engineering and Technology (IJMET), Volume 6, Issue 9, Sep 2015, pp. 30-42, Article ID: IJMET_06_09_004.

[7] V.V.Mane, Amit Sata and M. Y. Khire. "New Approach to Casting Defects Classification and Analysis Supported by Simulation". A Review, Technical papers year 2011.