

A Review on Metal casting process defects and Remedies

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Abstract

Foundry industries in developing countries suffer from poor quality and productivity due to involvement of number of process parameter. Even in completely controlled process, defect in casting are observed and hence casting process is also known as process of uncertainty which challenges explanation about the cause of casting defects. In order to identify the casting defect and problem related to casting, the study is aimed in the research work. This will be beneficial in enhancing the yield of casting. Beside this, standardization (optimization) of process parameter for entire cycle of manufacturing of the critical part is intended in the proposed work. This study aims to finding different defects in casting, analysis of defect and providing their remedies with their causes. In this paper an attempt has been made to list different types of casting defects and their root causes of occurrence. This paper also aims to provide correct guideline to quality control department to find casting defects and will help them to analyse defects which are not desired.

1. Introduction

Casting is a process which carries risk of failure occurrence during all the process of accomplishment of the finished product. Hence necessary action should be taken while manufacturing of cast product so that defect free parts are obtained. Mostly casting defects are concerned with process parameters. Hence one has to control the process parameter to achieve zero defect parts. For controlling process parameter one must have knowledge about effect of process parameter on casting and their influence on defect. To obtain this all knowledge about casting defect, their causes, and defect remedies one has to be analyse casting defects. Casting defect analysis is the process of finding root causes of occurrence of defects in the rejection of casting and taking necessary step to reduce the defects and to improve the casting yield. In this review paper an attempt has been made to provide all casting related defect with their causes and remedies. During the process of casting, there is always a chance where defect will occur. Minor defect can be adjusted easily but high rejected rates could lead to significant change at high cost. Therefore, it is essential for die caster to have knowledge on the type of defect and be able to identify the exact root cause, and their remedies.

Keywords: Metal casting, casting yield, defects, Remedies, parameters, optimization

2. CASTING DEFECT CAN BE CLASSIFIED AS FOLLOWS

2.1. Filling related defect

2.2. Shape related defect

2.3. Thermal defect

2.4. Defect by appearance These defects are explained as follows.

2.1. Filling related defect

2.1.1. 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 slag's or oxides. The defects are nearly always located in the cope part of the mould in poorly vented pockets and undercuts.

2.1.1.1. Possible causes Resin-bonded sand

Inadequate core venting Excessive release of gas from core Excessive moisture absorption by the cores Low gas permeability and Moisture content of sand too high, or water released too quickly etc.

2.1.1.2. Remedies

Improve core venting, provide venting channels, ensure core prints are free of dressing Reduce amounts of gas. Use slow-reacting binder. Reduce quantity of binder. Use a coarser sand if necessary. Apply dressing to cores, thus slowing down the rate of heating and reducing gas pressure. Dry out cores and store dry etc.

2.1.2. 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.

2.1.2.1. Possible causes

Lustrous carbon content too low Proportion of low-melting-point substances too high Moulding plant Uneven mould compaction Gating and pouring practice Uneven distribution of inflowing metal with resultant over-heating

2.1.2.2. Remedies

Increase proportion of lustrous carbon producer, which results in positive separation between mould and metal. Use purer silica sands, Ensure uniform compaction. If necessary, increase heat removal from the moulds. Gating and pouring practice Even out incoming metal flow etc.

2.1.3. Sand inclusion

Sand inclusion and slag inclusion. They are inclusion defects. Looks like there are slag inside of metal castings. Irregularly formed sand inclusions, close to the casting surface, 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 slag's, and only become visible during machining.

2.1.3.1. Possible causes

core setting or assembling of moulding flasks Uneven compaction of moulds, Low computability Bentonite content too low, Inert material content too high Lump content too high content of lustrous carbon producer Resin-bonded sand Low core strength Excessive core mismatching Gating and pouring practice

2.1.3.2. Remedies

Carefully blow out mould cavities Improve pattern plates, increase pattern tapers and radii. Heat pattern plates and, if necessary, use release agent. Check the moulding plant for uniform flask stripping and overhaul moulding plant as necessary Automate core-setting Raise compactability and thus plasticity of the sand • Increase bentonite content. Use bentonite with high specific binding capacity. Improve bentonite development by ex-tending mixing time or by pre wetting used sand Reduce inert dust content. Decreasing the dust content reduces lumps in the sand. Reduce high rate pouring in gating system etc.

2.1.4. 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.

2.1.4.1. Possible Causes

Lack of fluidity in molten metal Faulty design Faulty gating

2.1.4.2. Remedies:

Adjust proper pouring temperature Modify Design Modify gating system.

2.1.5. Misrun

Misrun defect is a kind of incomplete casting defect, which causes the casting uncompleted. The edge of defect is round and smooth.

2.1.5.1. Possible Causes

Lack of fluidity in molten metal Faulty Design Faulty gating

2.1.5.2. Remedies

Adjust proper pouring temperature Modify Design Modify gating system.

2.1.6. Gas porosity

The gas can be from trapped air 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. The swirling flow can cause them to become elongated.

2.1.6.1. Possible Causes

Metal pouring temperature too low. Insufficient metal fluidity e.g. carbon equivalent too low. Pouring too slow. Slag on the metal surface.

2.1.6.2. Remedies

Increase metal pouring temperature. Modify metal composition to improve fluidity. Pour metal as rapidly as possible without interruption. Improve mould filling by modification to running and gating system. Remove slag from metal surface.etc

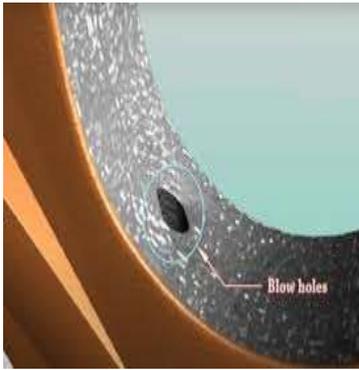


Fig. blowholes.

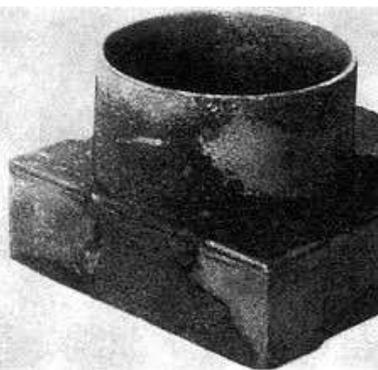


Fig. sand burns.



Fig. sand inclusion.



Fig. cold shuts.



Fig. Misrun.



Fig. Gas porosity

Fig. The above figures shows filled related defects

2.2. Shape defects

2.2.1. Mismatch defect

Mismatch in mould defect is because of the shifting mouldings flashes. It will cause the dislocation at the parting line.

2.2.1.1. Possible causes • A mismatch is caused by the cope and drag parts of the mould not remaining in their proper position. • This is caused by loose box pins, inaccurate pattern dowel pins or carelessness in placing the cope on the drag.

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

2.2.2. Distortion or warp Warped Casting Distortion due to warp age is known as warp defect.

2.2.2.1. Possible causes

Distortion due to warp age can occur over time in a casting that partially or completely liberates residual stresses.

2.2.2.2. Remedies

Common practice in iron casting is normalizing heat treatment to remove residual stress. In aluminium casting, a straightening between quench and aging might be required.

2.2.3. Flash defect Flash can be described as any unwanted, excess metal which comes out of the die attached to the cavity or runner.

2.2.3.1. Possible causes

Damage to die faces and die components Parts of the die have insufficient strength Bending, crowning of stretching of dies Cavities offset from centre of platen Insufficient machine clamp-up.

2.2.3.2. Remedies

If your sprue is very tall and the casting covers a wide area of the mould face, it's very possible for the mould to actually be forced up by the hydrostatic pressure of the metal. The seriousness of this depends density of the metal and the weight of the mould fighting it. The solution here is very simple: weight down the mould.

Conclusion

Casting defects can significantly impact the quality and functionality of manufactured parts, leading to costly delays and product failure. Understanding the causes behind these defects is crucial for optimizing production efficiency. Whether you are working with metal casting, machining parts or other types of casting processes, identifying and addressing casting defects can improve the final product's durability and precision. In this research paper different casting defects are studied. By referring different research papers causes and their remedies are listed. These will help to quality control department of casting industries for analysis of casting defect. This study will definitely be helpful in improving the productivity and yield of the casting. One of the side this classification of defects helps in die caster in the stage of identification of the defects can be detected. Rejections of the casting on the basis of the casting defect should be as minimized and all the above research is heading in the same direction

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