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Identification of casting product defects &its improvement Remedies: Review

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ABSTRACT In this paper the statistical analysis is aimed to optimize process parameters at the case study i.e R A ALLOY STEEL, VADODARA, GUJARAT to minimize the major cast iron. This project is intended to observe just of steel casting & cat iron defects which are severe in nature in their nature i.e. ., directional solidification, misalignment & surface finishing. In order to minimize these defects, process parameter ere studied like –gas defects, Mold permeability, Pouring Temperature, Directional solidification, Misrun. In order to obtain a representative experimental data it was used as factorial experiment. The relative influence of each factor on the casting defect/porosity/ was determined and suggestions have been given using the Statistical Analysis method by optimizing the process parameters.

Keywords: *Steel Casting, Shrinkage defects, gas defects, mold and melting furnace*

1. INTRODUCTION

Casting is a process which conveys danger of disappointment event amid all the process of achievement of the completed item. Thus important move ought to be made while assembling of cast item so defect free parts are acquired. For the most part casting defects are worried about process parameters. Consequently one needs to control the process parameter to accomplish zero defect parts. For controlling process parameter one must know about impact of process parameter on casting and their effect on defect.

Foundry industries in developing nations experience the ill effects of poor quality and efficiency to contribution of number of process parameters in casting process. Indeed, even in a totally controlled process, defects in casting process is otherwise called process of vulnerability which challenges clarification about the reason for casting defect. There are such a significant number of factors in the creation of a metal casting that the reason is frequently a mix of a few factors instead of a solitary one. Every applicable datum identified with the generation of the casting defect is recognized an endeavor to dispense with the defect by making suitable remedial move is fundamental for quality improvement.

To get this all information about casting defect, their causes, and defect cures one must be examine casting defects. Casting defect examination is the process of discovering underlying drivers of event of defects in the dismissal of casting and making essential move to decrease the defects and to enhance the casting yield. In this review paper an endeavor has been made to furnish all casting related defect with their causes and cures.

Amid the process of casting, there is dependably a possibility where defect will happen. Minor defect can be balanced effortlessly yet high rejected rates could prompt noteworthy change at high cost. Subsequently it is basic

for pass on caster to have information on the sort of defect and have the capacity to recognize the correct underlying driver, and their cures.

❖ VARIOUS CASTING DEFECT

2.1 *FILLING RELATED DEFECTS*

2.1.1. *BLOWHOLE*

It is cavity defect, which is divided into 2 types are pinhole & subsurface blowhole. Pinhole is very small hole. Subsurface can be seen after the machining process .the defect is mostly seen in cope.

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 of the core sand
Clay-bonded sand
• Moisture content of sand too high, or water released too quickly
• Gas permeability of the sand too low
• Sand temperature too high
• Bentonite content too high
• Too much gas released from lustrous carbon producer

2.1.1.2. *Remedies*

Resin-bonded sand
• 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, thus reducing absorption of water and reducing gas pressure.
Clay-bonded sand
• Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust content.
• Improve gas permeability. Endeavour to use coarser sand. Reduce bentonite and carbon carrier content.
• Reduce sand temperature. Install a sand cooler if necessary. Increase sand quantity.
• Reduce bentonite content. Use bentonite with a high montmorillonite content, high specific binding capacity and good thermal stability.
• Use slow-reacting lustrous carbon producers or carbon carriers with higher capacity for producing lustrous carbon. In the last instance, the content of carbon carriers in the molding sand can be reduced

2.1.2. *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.

2.1.2.1. *Possible Causes*

- Lack of fluidity in molten metal
- Faulty design
- Faulty gating

2.1.2.2. Remedies:

- Adjust proper pouring temperature

- Modify design
- Modify gating system

2.1.3. 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.

2.1.3.1. *Possible Causes*

· Lack of fluidity in molten metal
· Faulty design
· Faulty gating

2.1.3.2. *Remedies*

· Adjust proper pouring temperature
· Modify design
· Modify gating system

2.1.4. *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.

2.1.4.1. *Possible Causes*

· Metal pouring temperature too low.
· Insufficient metal fluidity e.g. carbon equivalent too low.
· Pouring too slow.
· Slag on the metal surface.
· Interruption to pouring during filling of the mould.
· High gas pressure in the mould arising from molding material having high moisture and/or volatile content and/or low permeability.
· Lustrous carbon from the molding process.
· Metal section too thin.
· Inadequately pre-heated metallic moulds.

2.1.4.2. *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.
· Reduce gas pressure in the mould by appropriate adjustment to molding material properties and ensuring
· Adequate venting of moulds and cores.
· Eliminate lustrous carbon where applicable.
· If possible, modify casting design to avoid thin sections.
· Ensure metal moulds are adequately pre-heated and use insulating coatings.

2.2. *SHAPE DEFECTS*

2.2.1. *MISMATCH DEFECT*

Mismatch in mold defect is because of the shifting molding 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 molding box and closing pins.

2.3. *THERMAL DEFECTS*

2.3.1. *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.

2.3.1.1. *Possible causes*

· Shrinkage of the casting within the die
· Undercuts or damage in die cavities
· Uneven, or excessive, ejection forces
· Thermal imbalance in the die
· Insufficient draft in sections of the die
· Excessive porosity in critical regions of the part
· Product design not matched to the process
· Inadequate die design

2.3.1.2. *Remedies*

• Reduce dry strength, add saw dust/ coal dust
• Reduce pouring temperature
• Avoid superheating of metal
• Use chills
• Provide feeders
• Avoid early knockout. Give sufficient cooling time.
• Correct composition
• Reduce sharp corners

2.3.2. *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. 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. 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.

2.3.2.1. *Possible causes*

The density of a die casting alloy in the molten state is less than its density in the solid state. Therefore, when an alloy changes phase from the molten state to the solid state, it always shrinks in size. This shrinkage takes place when the casting is solidifying inside a die casting die. At the centre of thick sections of a casting, this shrinkage can end up as many small voids known as 'shrinkage porosity'. If the shrinkage porosity is small in diameter and confined to the very centre of thick sections it will usually cause no problems. However, if it is larger in size, or joined together, it can severely weaken a casting. It is also a particular problem for castings which need to be gas tight or water tight'.

2.3.2.2. *Remedies*

The general technique for eliminating shrinkage porosity is to ensure that liquid metal under pressure continues to flow into the voids as they form.

2.4. *DEFECTS BY APPEARANCE*

2.4.1. *METALLIC PROJECTION*

Joint flash or fins Flat projection of irregular thickness, often with lacy edges, perpendicular to one of the faces of the casting. It occurs along the joint or
Parting line of the mold, at a core print, or wherever two elements of the mold intersect.

2.4.1.1. *Possible causes*

Clearance between two elements of the mold or between mold and core; Poorly fit mold joint.

2.4.1.2. *Remedies*

Care in pattern making, molding and core making. Control of their dimensions; Care in core setting and mold assembly.

2.4.2. *CAVITIES*

Blowholes, pinholes, Smooth-walled cavities, essentially spherical, often not contacting the external casting surface (Blowholes). The defect can appear in all regions of the casting.

2.4.2.1. *Possible causes*

Blowholes and pinholes are produced because of gas entrapped in the metal during the course of solidification:

2.4.2.2. *Remedies*

Make adequate provision for evacuation of air and gas from the mold cavity; Increase permeability of mold and cores.

2.4.3. *DICONTINUITIES*

Hot cracking. A crack often scarcely visible because the casting in general has not separated into fragments. The fracture surfaces may be discolored because of oxidation. The design of the casting is such that the crack would not be expected to result from constraints during cooling.

2.4.3.1. *Possible causes*

Damage to the casting while hot due to rough handling or excessive temperature at shakeout.

2.4.3.2. *Remedies*

Care in shakeout and in handling the casting while it is still hot; Sufficient cooling of the casting in the mold.

2.4.4. *INCORECT DIMENSSION OR SHAPE*

Distorted casting inadequate thickness, extending over large areas of the cope or drag surfaces at the time the mold is rammed.

2.4.4.1. *Possible causes*

Rigidity of the pattern or pattern plate is not sufficient to withstand the ramming pressure applied to the sand. The result is an elastic deformation of the pattern and a corresponding, permanent deformation of the mold cavity. In diagnosing the condition, the compare the surfaces of the pattern with those of the mold itself.

2.4.4.2. *Remedies*

Assure adequate rigidity of patterns and pattern plates, especially when squeeze pressures are being increased.

2.4.5. *DEFECTIVE SURFACE*

Flow marks. On the surfaces of otherwise sound castings, the defect appears as lines which trace the flow of the streams of liquid metal

2.4.5.1. *Possible causes*

Oxide films which lodge at the surface, partially marking the paths of metal flow through the mold.

2.4.5.2. *Remedies*

· Increase mold temperature;
· Lower the pouring temperature;
· Modify gate size and location Tilt the mold
during pouring

❖ CONCLUSION

In this research work distinctive casting defects are examined. By alluding diverse research papers causes what's more, their cures are recorded. These will help to quality control bureau of casting ventures for investigation of casting defect. This investigation will be useful in enhancing the efficiency and yield of the casting. Dismissals of the casting based on the casting defect ought to be as limited and all the above research is heading a similar way.

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