Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 5, pp.3802-3806, May, 2015

International Journal of Recent Scientific Research

ISSN: 0976-3031

RESEARCH ARTICLE

DEFECT ANALYSIS IN A BLADE AND MEASURES TO MITIGATE IT USING NONTRADITIONAL OPTIMIZATION TECHNIQUE

Saravanan Kumar V[1], Dharmalingam S[2] and Pandyrajan R[3]

[1]Mechanical Engineering, R.V.S Technical Campus, Coimbatore
[2]Department, Mechanical Engineering, R.V.S Technical Campus, Coimbatore
[3]Karpagam University, Coimbatore

ARTICLE INFO

Article History:

Received 14th, April, 2015
Received in revised form 23th, April, 2015
Accepted 13th, May, 2015
Published online 28th, May, 2015

Key words:

ABSTRACT

In this paper, defects caused in casting process are identified, analyzed and minimized by obtaining the suitable remedial measures. Defect analysis using Non-destructive Testing (NDT) is an expedient way for controlling defects in Mechanical and Aerospace Systems. Defect Analysis means identifying, locating, interpreting, evaluating and generating corrective and preventive actions.

INTRODUCTION

A casting defect is an irregularity in the metal casting process that is much undesired. Some defects can be tolerated while others can be repaired, otherwise they must be eliminated. 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 output. In the process of casting, there can be 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 malfunctioned defects, and their preventive ways.

Methodology (Phases In Defect Analysis)

1. Selection of a component (casting component)
2. Capturing the defects (identification of Defects)
3. Analyzing the defects (causes for the defects)
4. Developing defect mitigation plan (remedial measures)
5. Implementing defect mitigation plan
6. Development of a defect free component.

Casting Component: Cooling blade

Blade used in a pump industry made of pure aluminum and grey cast iron (FG 200) is obtained to carry out defect analysis, the blade is used to transfer the cooling fluid into the system to remove the temperature. Capturing of the defects has been carried out using Non-destructive testing methods and remedial measures to overcome the defects also developed.

Fig.2 Blade made of pure aluminum

Corresponding author:* **Saravanan Kumar V
Mechanical Engineering, R.V.S Technical Campus, Coimbatore

Fig.3 Blade made of Grey cast iron

Identification of Defects

Defects in the component will be identified using NDT techniques (PT,UT, RT).Non-destructive testing (NDT) is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage. (i.e.) inspect or Examine without doing harm. Initial inspection revealed that Blow hole, pin hole and shape related defects due to grinding on the material for surface finishing are present in the component which results in the rejection of the component.(Blow hole and Grinding defect)

Analyzing the defects

Defect Analysis is a process of analyzing the nature of the defects and its root cause. Analysis of the defects is generally done using six sigma principles to find the best suitable remedial measure to mitigate the defect. The Six Sigma's problem solving methodology DMAIC has been one of several techniques used to improve quality. Six sigma heavily focuses on statistical analysis as it is data driven and is a methodical approach that drives the process improvements through statistical measurements and analyses. In view of the large number of factors that are responsible for the casting defects, the general statistical approach is not always the best.

Causes for Defects

Blow holes

- Inadequate core venting
- Excessive release of gas from core
- Excessive moisture absorption by the cores
- Moisture content of sand too high, or water released too quickly
- Gas permeability of the sand too low
- Sand temperature too high

Remedial Measures

Blow holes

- 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 coarser sand if necessary.
- Dry out cores and store dry, thus reducing absorption of water and reducing gas pressure.

Defect Mitigation Plan

Execution Process

- Cooling blade is selected and detect analysis is being carried out.
- Parameters in casting process and nature of the defects that occur in the component will be studied and analyzed using optimization technique.
- Root causes for the defects will be identified.
- Implementation of suitable remedial measures will be carried out to produce defect free component.
- Report for rejected and defect free component will be generated as per ASNT standards.

Developing defects mitigation plan and implementation

(Identification defects in components)

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. Air is present in the cavity before the shot. 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.

Possible Causes

1. Metal pouring temperature too low.
2. Insufficient metal fluidity e.g. carbon equivalent too low.
3. Pouring too slow.

4. Slag on the metal surface.
5. Interruption to pouring during filling of the mould.
6. High gas pressure in the mould arising from molding material having high moisture and/or volatile content and/or low permeability.
7. Lustrous carbon from the molding process.
8. Metal section too thin.
9. Inadequately pre-heated metallic moulds.

Remedies

1. Increase metal pouring temperature.
2. Modify metal composition to improve fluidity.
3. Pour metal as rapidly as possible without interruption. Improve mould filling by modification to running and gating system.
4. Remove slag from metal surface.
5. Reduce gas pressure in the mould by appropriate adjustment to moulding material properties and ensuring
6. Adequate venting of moulds and cores.
7. Eliminate lustrous carbon where applicable.
8. If possible, modify casting design to avoid thin sections.
9. Ensure metal moulds are adequately pre-heated and use insulating coatings.

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.

Possible causes

Resin-bonded sand

1. Inadequate core venting
2. Excessive release of gas from core
3. Excessive moisture absorption by the cores
4. Low gas permeability of the core sand Clay-bonded sand
5. Moisture content of sand too high, or water released too quickly
6. Gas permeability of the sand too low
7. Sand temperature too high
8. Bentonite content too high
9. Too much gas released from lustrous carbon producer

Remedies

Resin-bonded sand

1. Improve core venting, provide venting channels, ensure core prints are free of dressing.
2. Reduce amounts of gas. Use slow-reacting binder. Reduce quantity of binder. Use coarser sand if necessary.
3. Apply dressing to cores, thus slowing down the rate of heating and reducing gas pressure.
4. Dry out cores and store dry, thus reducing absorption of water and reducing gas pressure by Clay-bonded sand
5. Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust content.
6. Improve gas permeability. Endeavour to use coarser sand. Reduce bentonite and carbon carrier content.
7. Reduce sand temperature. Install a sand cooler if necessary. Increase sand quantity.
8. Reduce bentonite content. Use bentonite with a high montmorillonite content, high specific binding capacity and good thermal stability.
9. 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 moulding sand can be reduced

Shape defects

Mismatch defect

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

Possible causes

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

Remedies

1. Check pattern mounting on match plate and Rectify, correct dowels.
2. Use proper molding box and closing pins.

Defect Free Component

The identified remedial measures are implemented and defect free component is produced with same material and die in sand casting**.**LPT and UT were carried out in the component to capture the defects if any after analyzing.

Liquid penetrant testing

Fig.4 PT in blade-2

Ultrasonic testing

Fig.5 UT in blade-2

Inspection Report of Defect free component

Nest Technical Solutions Pvt. Ltd
13, Kamala Colony, Lakshmipuram
Kamarajar Road, Peelamedu (PO),
Coimbatore - 641 004.

The Symbol of Perfection

ULTRASONIC TEST REPORT

Client : BHARATHKUMAR.G	Report Date : 23.02.2015	Report No: U T/02	Page No : 2 of 2
Spec No :1050 no 2	Tested on : 21.02.2015		Tested Complete :21.02.2015
Reference Procedure Specification : ASME SEC VIII			
Surface Condition : Medium Smooth	Surface Temp : At room temp	Scanning : All Area	
Equipment & Technique			
Model : Modsonic – Einsten II	SL No : E3422-0612	Manufacturer : Modsonic	
Couplant : Grease	Cable Type : Big Lemo to Small Lemo	Technique : A Scan	
Basic Calibration Block : V1 IIW			
Range : 0 to 25 mm Mode: SINGLE			

Probe Angle	0°	45°	60°	70°
Sl. No	0002			
Dimension	10 Dia			
Frequency	4 MHz			
Velocity m/s	5920			
Sensitivity	1.5 mm			
Ref gain	50dB			
Scan gain	58dB			
Range	0 – 10mm			

Item /Mark No	Spec	Test Area	Defects absorbed in one square inch	Remarks
ALUMINIUM	1050	ALL AREA OF THE PLATE	No defects	-

INSPECTED BY	NAME	SIGNATURE	DATE
ASNT LEVEL II	SARAVANAN. N		23.02.2015

Ph: 0422- 4208545
info.cbe@nestndt.com
www.nesttechnicalsolutions.com

Optimization (Future scope)

Non-traditional optimization techniques are mostly inspired from nature and apply nature like processes to solutions, in order to serve as very flexible and robust tools for complex combinatorial optimization problems.

Types of Optimization Techniques

- Traditional approach
- Non-Traditional approach

Traditional approach
Eg: Taguchi quality loss function
Sixsigma

Non-Traditional approach
Eg: Genetic algorithm (GA)
Differential Evoluation (DE)

Genetic algorithm (GA)

The power of this algorithm stems from its ability to exploit historical information structure from previous solution in an attempt to increase the performance of future solutions.
GA manipulates coded versions of the problem parameters instead of the parameters themselves.

Input parameters

- Material molten temperature
- Pouring temperature
- Die material
- Casting method
- Shape of the component

CONCLUSION

In this paper casting defects for a selected component are studied and analyzed. A non -traditional optimization approach is used to identify and mitigate the defects. It will help the quality control department of casting industries to analysis the casting defects with minimum cost and to improve the production to satisfy the customer needs. If castings are inspected using nontraditional approach, rejections in the foundry can be controlled.

If this non traditional method is introduced in future, the casting defects can be reduced up to 10% by proper selection of Input parameters.

Rejection of the casting on the basis of the casting defects should be as minimum as possible for better quality. One can continuously strive for change in sand mixing process parameters until rejections are under control.

References

1. Rajesh Rajkolhe, J. G. Khan (2014) “Defects, Causes and Their Remedies in Casting Process: A Review’’ *International Journal of Research in Advent Technology*, Vol.2, No.3.
2. Sunil Chaudhari, Hemant Thakkar (2014)“Review on Analysis of Foundry Defects for Quality Improvement of Sand Casting’’.*Int. Journal of Engineering Research and Applications*.
3. Uday A. Dabade , Rahul C. Bhedasgaonkar (2013)“Casting Defect Analysis using Design of Experiments (DoE) and Computer Aided Casting Simulation Technique’’- Forty Sixth CIRP Conference on Manufacturing Systems.
4. Dr D.N. Shivappa , Mr Rohit (2012) “Analysis of Casting Defects and Identification of Remedial Measures – A Diagnostic Study” *International Journal of Engineering Inventions* ISSN: 2278-Volume 1, Issue 6,PP: 01-05.
5. B. Borowiecki, O. Borowiecka, (2011) “Casting defects analysis by the Pareto method”- Archives of foundry engineering ISSN (1897-3310) Volume 11 Special Issue 3.

6. A.P.More , Dr.R.N.Baxi,(2011)"Review of Casting Defect Analysis to Initiate the Improvement Process" *Int J Engg Techsci* Vol 2,page.no.292-295.
7. L.A. Dobrzański, M. Krupiński (2006)"Methodology of analysis of casting defects" *Journals of Achievements in Materials and Manufacturing Engineering*, VOLUME 18 ISSUE 1-2.

How to cite this article:

Saravanan Kumar V *et al*., Defect Analysis In A Blade And Measures To Mitigate It Using Nontraditional Optimization Technique. *International Journal of Recent Scientific Research Vol. 6, Issue, 5, pp.3802-3806, May, 2015*

****