

Analysis of Casting Defects for Finding out Its Possible Remedies through Simulation A Case of Box Parallel

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Abstract

The quest of quality in the field of casting is rising exponentially due to globalization and stringent tolerances. Foundries are faced challenges to produce high grade casting with least cost. To achieve this, experimental casting, especially for individual casting or small runs before mass production, are uneconomical which tempts to do casting simulation. The simulation gives the proper idea about feasibility of design of gating system of Box Parallel and also Sand plays an important role in deciding the quality of casted Box Parallel.

Keywords: Quality, Casting, Globalization, Foundries, Cost

INTRODUCTION

From an ancient time, casting is one of the widely used process to make a various products. By looking at the present market scenario, the quality is a major concern for any casted products to survive in it. Defects are the prime factors affecting the quality of any product. Due to that the credibility of any casting industry will also be affected. Depending upon the type of casting process used and other various factors like moulding sand, moulding methods etc. Few defects are more prominent than the others. These defects are the major reasons for most of the rejections of the casted parts. Considering these facts an attempt is to work on reducing or eliminating casting defects in a product called BOX PARALLEL of size 350*350*250 through simulation and also by analysis of the accumulate theoretical and practical data.

Typical Operation Process Chart

The operation process chart described below in Figure 1 is made after making a thorough study of the foundry process of Box Parallel under the process.

The present procedure followed in the manufacturing of the casting at MICRO FLAT DATUM is proper with appropriate number of inspection stages. This inspection stages are for constant monitoring over the process in order to find and eliminate the errors if any occurs. The operation process chart shown in Figure 1.

OPERATION PROCESS CHART:

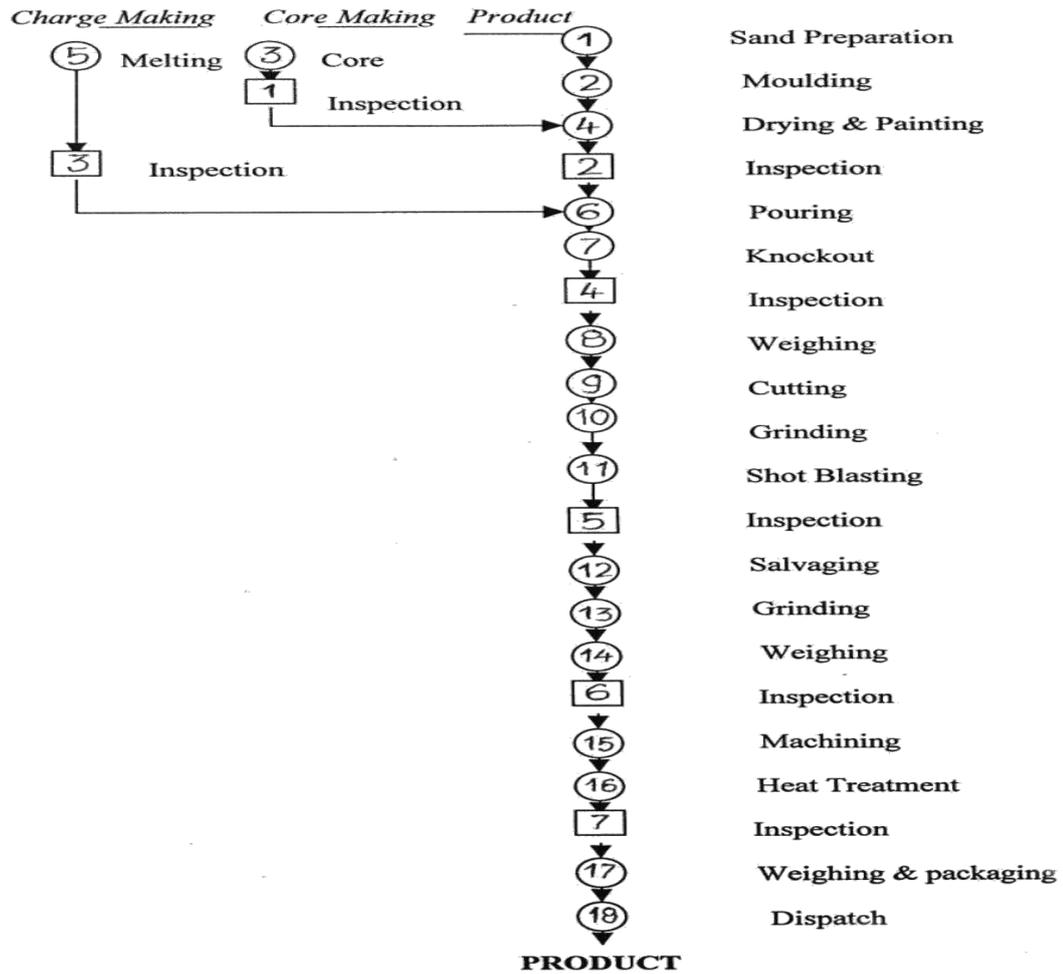


Figure – 1 Operation process chart

PRODUCT DESCRIPTION

- Hollow Box Parallel
- Product Weight: - 85.700 kg
- Material: - FG 220
- Dimension:- 350*350*250
- Density: - 2.80kg/m³

An angle plate is a work holding device used as a fixture in Metalworking. The angle plate is made from high quality material (generally spheroidal cast iron) that has been stabilized to prevent further movement or distortion.

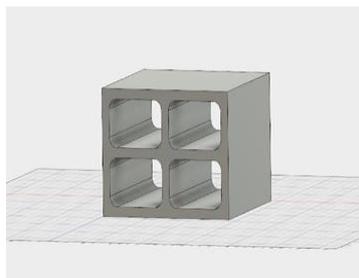


Figure – 2 Box Parallel

In the present paper a case of cast iron Box angle plate is considered for analysis. Blow holes & porosity are the major defects found during casting. The reasons for these defects may be directional solidification, improper gating design or location of riser. So, an attempt is made to simulate all these parameters which in turn gives defect free casting.

P.D. Chauhan, Mohit Anuvadiya, Vivek Chauhan proposed the methods & techniques of feeding and gating system design to increase the yield of casting. Aniruddha Joshi and L. M. Jugalkar proposed the pareto principle and cause effect diagram to identify and evaluate different defects and causes for these defects responsible for rejection of components at different stages of manual metal casting operations. Mr. Patil Sachin S, Prof. Naik Girish R. impacts on the quality of casting which depends on quality of sand, method of operation, quality of molten metal etc. To produce defect free casting, attention have to be given towards controlling the process parameter.

MAJOR DEFECTS OBSERVING IN INDUSTRY

Cavities

Causes:-

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

Remedies:-

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

Blow Hole

Causes:-

- 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

Remedies:-

- Reduce amounts of gas. Use a coarser sand if necessary.
- Use slow-reacting binder, Reduce quantity of binder.
- 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.

Gas Porosity

Causes:-

- Metal pouring temperature too low
- Insufficient metal fluidity e.g. carbon equivalent too low
- Interruption to pouring during filling of the mould.
- Inadequately pre-heated metallic moulds.

Remedies:-

- Increase metal pouring temperature.
- Modify metal composition to improve fluidity.
- Remove slag from metal surface.
- If possible, modify casting design to avoid thin sections

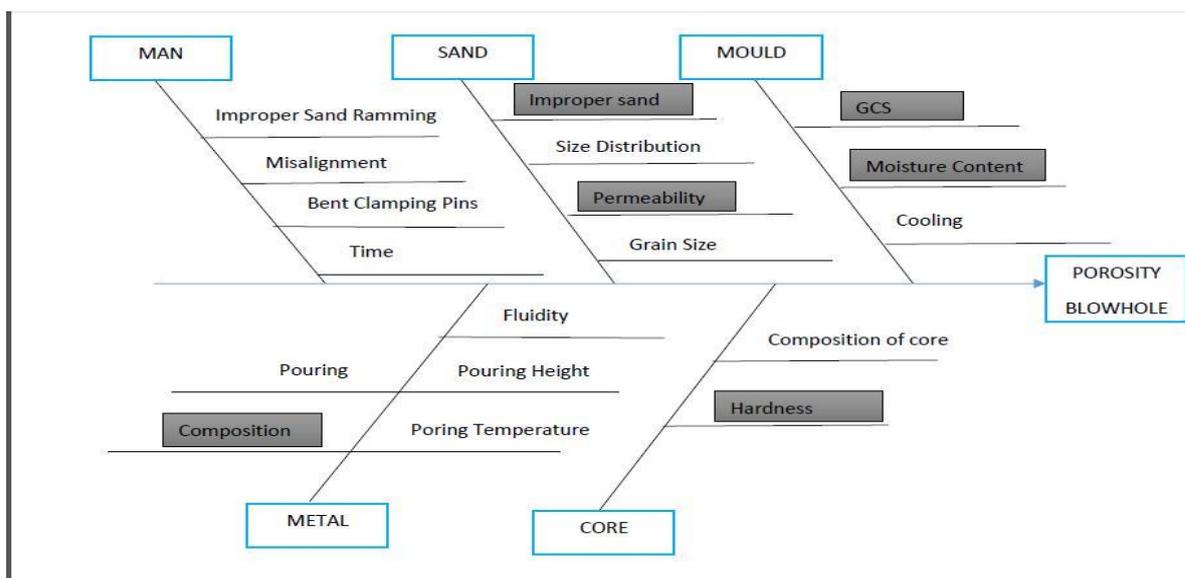


Figure-3 Cause Effect Diagram for Box Plate Angle

Figure 3 shows major causes of defects occurred in final goods. These are mainly Green Compressive Strength, Mould Hardness, Permeability and Moisture Content of Sand. By varying content of components of sand it will reduced the defects produced in final goods.

ELEMENTS OF SAND USED IN PROCESS

Total of sand 170 kg, the content and additives are as follows:

- Facing Sand – 20Kg
- Refractory Sand – 150Kg
- Molasses – 6lit
- Bentonite – 0.8Kg

CASTING DEFECTS IN PRODUCT

Here we are gating mainly Blow Holes, Pin Holes and Gas Porosity.

Causes of Defects in Product:

- Main cause of the blow hole is evolution of different types of gases and various reactions taking place during mold filling phenomenon.
- Gas is formed in the mold box by two ways.
- Due to mold and core gases: Mold and core is contain binder so which liberate a gas on heating. This gas is not escape from the mold so it is trapped in the liquid molten metal.
- Due to green sand : In the green sand mold moisture and sea coal is added so it is liberate a gas while molten metal is pour in the mold cavity.

SOLUTION OF DEFECTS

- Improve core venting, provide venting channels, and 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.
- Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust contents.
- Improve gas permeability. Reduce bentonite and carbon carrier content.



Fig – 4 New Gating System

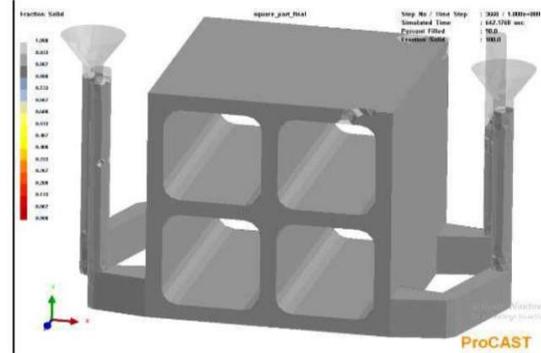


Fig – 5 Existing Gating System

Figures 4 and 5 shows the existing and Modified Gating System of Product.

The Assembly of channels which facilitates the molten metal to enter into the mold cavity is called the gating system. Alternatively, the gating system refers to all passage ways through which molten metal passes to enter into the mold cavity. The nomenclature of gating system depends upon the function of different channels which they perform.

- Down gates or sprue
- Cross gates or runners
- Ingates or gates

The metal flows down from the pouring basin or pouring cup into the down gate or sprue and passes through the cross gate or channels and ingates or gates before entering into the mold cavity.

$$Q = A_1 V_1 \approx A_2 V_2$$

Selection of optimum pouring time is major problem in foundries. Some empirical formulas are setup to find the pouring time for a particular size & shape of the casting. Here, only Grey Cast is taken into consideration

For Castings weighing more than 1000 lbs

$$\text{Pouring time} = K \left[0.95 + \frac{T}{0.853} \right] \sqrt[3]{W}$$

For Castings weighing less than 1000 lbs

$$\text{Pouring time} = K \left[0.95 + \frac{T}{0.853} \right] \sqrt{W},$$

Where K= Fluidity factor = (Fluidity of specific iron)/40

Table 1 Values old and modified Gating System parameters

PARAMETER	CURRENT SYSTEM(IN mm)	MODIFIED CALCULATION(in mm)
HEIGHT OF INGATE	279	279
DIA. OF INGATE	25.4	38
HEIGHT OF RISER	317	81
DIA OF RISER	25.4	50
POURING BASIN HEIGHT	38	50
POURING BASIN DIA	78.35	97
POURING TIME(sec)	38.75	75.55

The Table 1 shows the values of different parameters of both existing and modified gating system.

CONCLUSION

- Based on modifications in existing gating system design of sand casting, the major problem of gas porosity is removed. The modification also resulted in the improvement of casting yield from 76% to 87%. These modifications are tested through simulations with procast & E Foundry and it's found to be valid while trial run production at MICROFLAT PVT.LTD.
- With the help of minor changes in sand properties like GCS (Green Compressive Strength), Moisture, Compatibility and Permeability we can get sound casting.

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REFERENCES

- O.P.Khanna – Foundry Technology
- Kanishka Bedi – Quality Management
- <http://efoundry.iitb.ac.in/TechnicalPapers/2011/Mane-IFC-CastingDefects.pdf>
- Aniruddha Joshi, L.M.Jugulkar, Investigation and Analysis of Metal Casting Defects and Defect Reduction by using Quality Control Tools. International Journal of Mechanical and Production Engineering, ISSN: 2320-2092, Volume-2, Issue-4, April-2014.
- Mr Patil Sachin S, Prof. Naik Girish R. Defect Minimization in Casting through Process Improvement. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)e-ISSN: 2278-1684,p-ISSN: 2320 334X, Volume 14, Issue 2, Ver. I, (Mar. - Apr. 2017), PP09-13.
- Bhushan Shankar kamble. Assistant Prof. Analysis of different sand casting Defects in a Medium scale foundry Industry. International Journal of Innovative Research in Science, Engineering and Technology. Vol.5, Issue 2, February 2016.
- P.D.Chauan, Mohit Anuvadiya, Vivek Chauhan, Feeding and Gating System Design and Simulation of Flange Roller of Hydrators for Yield Melioration. ICRISSET2017-BVM Engineering College,Kalpa Publications in Engineering, vol. 1 pp. 548 to 556.