CASTING DEFECTS ANALYSIS OF SWASH PLATE (PVB10 YOKE) USING SIMULATION

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Abstract – *In India most of the foundries follow the traditional method, based on the experimental and error-making process that results in a high rate of rejection and as a necessary period of development. Foundries still use trial and error methods to solve simulation problems. There are advantages to using a more ethical approach to defining, identifying and determining the origin of a feature. Powerful strategies such as improper mapping, questioning to minimize causes and design of dynamic detection and dynamic control are tested. The actual history of the case in solving shrinkage porosity is explained to show these methods in practical application. The present study demonstrates the benefits of using simulation software to analyze different defects such as shrinkage porosity, cold closures, blow holes. Small-scale industrial enterprises face high levels of disposal. Therefore, research aimed at establishing rejection control can help the emerging industries in the area to identify and control factors that contribute to rejection.*

Imitation simulations aid in visualising mould filling and strengthening the spread; forecasting related mistakes such as cold closures, porosity shrinks, and solid areas; and improving simulation design to attain the quality you desire with a high yield. The flow and solidification of molten metals, on the other hand, is a very complex state that is difficult to accurately model using traditional computation tools, particularly when the geometric component is complex and the needed inputs are unavailable.

The process of modelling the real thing with a set of mathematical formulas is the foundation of simulation software. Simulation software is extensively used to create tools in order to ensure that the final product is as near to the design specifications as feasible without modifying the process. In this paper used Auto-cast simulation software for finding root cause of casting defect. For minimize shrinkage defect use auto-cast simulation software find out the root cause. Taking the corrective action and reduced rejection percentage of casting defect of PVB10 Yoke.

Key Words: casting defect, casting simulation, shrinkage porosity, PVB1 Yoke.

1. INTRODUCTION

1. To make a mould, draw a pattern in sand.
2. Create a method that incorporates the pattern and sand.
3. Take away the pattern.
4. Molten material is poured into a mold.
5. Solidifies.

PVB10 Yoke is part of hydraulic cylinder. For production of high-quality casting component defect must be decrease. Finding root cause of casting defect use the auto-cast simulation software, in this process used the auto-cast simulation reduced the rejection percentage of casting defect and improve the quality of casting component.

2. LITERATURE REVIEW

RAJESH RAJKOLHE, J. G. KHAN (2014): has done a lot of research on throwing mistakes and how to fix them. Due to the inclusion of a variety of process steps, growing industries in underdeveloped nations suffer from low quality and productivity. An mistake in the experiment is found even in a totally controlled process, which is why the simulation process is also known as the uncertainty process, which questions the explanation for the reason of the simulation injury.

VIVEK V. YADAV and SHAILESH J. SHAHA (2016): A systematic strategy to eliminating sand holes in cylinder head distribution was investigated. They discovered that a blow hole in a single cylinder head's rocker surface is a big issue. To combat this, data is collected using Pareto Analysis, and several quality control tools are employed to locate the cause of the strike holes, including Defect Location, Kaizen Improvement Principle, Brainstorming Session, Why-Analysis, Corrective Actions, and Prevention Measures. They suggested the practice of cleaning the Central vent before assembling the mold box and attaching the wet green sand to the central gas area to overcome the cracks in the holes.

UDAY A. DABADE AND RAHUL C. BHEDASGAONKAR (2013): focused on employing Design of Experiments and Computer Aided Casting Simulation Techniques to measure impairment. They're investigating sand-related flaws and changes in green sand casting. They used a Taguchi-based orthogonal system for testing and analysis was performed using Minitab Software to analyze variability and content structure analysis. They also work on shrinkage porosity analysis using a simulation model by introducing a new hacking system design. Therefore, the results obtained

with the new gating and feeding system reduced shrinkage porosity by about 15% and yield improvement by about 5%

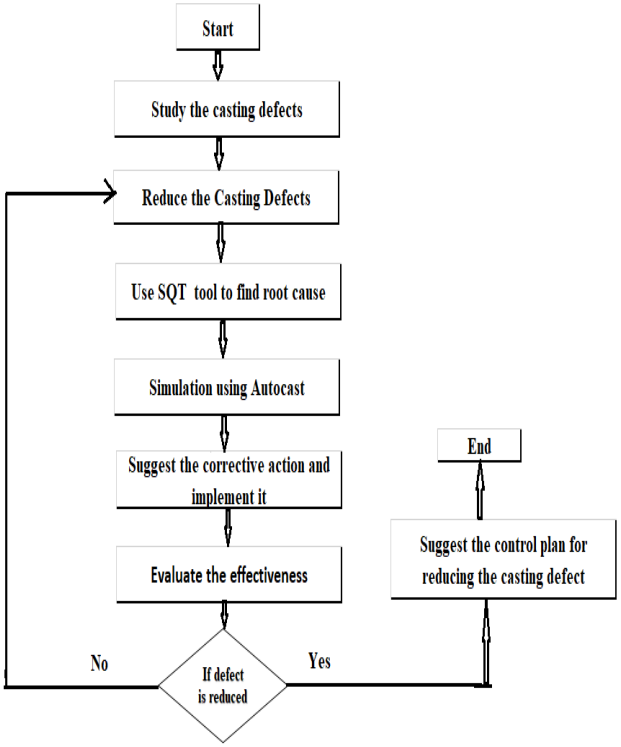
BEHERA ET AL. (2011): has suggested that the application of computer aided methoding, and casting simulation in foundries can minimize the bottlenecks and non-value-added time in casting development, as it reduces the number of trial casting required on the shop floor. Here an attempt has been made to solve the shrinkage defects occurring in an industrial component using AutoCAST-X software.

Borowiecki 2011: Study the major defects leading to higher casting rejection casting defects are arises due to incorrect getting system to stop difficulty getting system in increases the defect in casting. The paper suitable solutions for each defect due to party getting system various defect are formed such as porosity slag in culture shrinkage there paper suggestion of getting system increase the quality of product.

3. METHODOLOGY

Casting defect analysis is the process of finding root causes of casting defect and taking corrective action on it and reduced rejection and improves the quality of casting.

Figure 1 it is Flow chart and indicates procedure to reduce casting defect.



4. DATA COLLECTION AND REJECTION ANALYSIS

4.1 Defect in the swash plate for first trial(PVB10 Yoke)

First study the casting defect found in the swash plate (PVB10 Yoke). There are two major defects occur in swash plate (PVB10 Yoke) which is shrinkage porosity, sand fusion, blow hole study this defect in detail.

The first trial was taken on the date 24-8-2019. For the first trial design of drag and cope pattern is given below.

Fig1. Drag and cope pattern of swash plate for first trial

DEFECTS	Shrinkage porosity	Sand Fusion	Blow Hole
REJECTED QUANTITY	10	3	4

Poured Quantity	Rejected Quantity	Rejection (%)
40	17	42.5

4.2 REJECTION ANALYSIS

For finding the root cause of this defect use different Statistical quality tools. Statistical quality tools provide the root cause of this defect, after knowing the root cause apply corrective action on it and reduced casting defect.

I. Ishikawa diagram for analyzing defects in swash plate (PVB10 Yoke)

A fishbone diagram, also known as a cause-and-effect diagram or an Ishikawa diagram, is a technique for categorizing the possible causes of a problem in order to evaluate the root causes. This method is used to find all significant flaws. Man, machine/tool, process/method, and substance are the four general categories that would be

used to describe the triggers. This technique is used to find original potential reasons for all four main defects, which may be extracted from expert opinion, field study, or previous work. Ishikawa's diagram makes possible choice of five main areas which are responsible for failures formation. These areas are; accepted technology in investigated firm casting is realized by means of sand mould with partly automized production line and by manual pouring of mould; this technology, as every other, possesses its own advantages and defects which are responsible for formation of foundry defects, man-qualifications, experience of workers, engagement in works which in significant manner influences final product quality

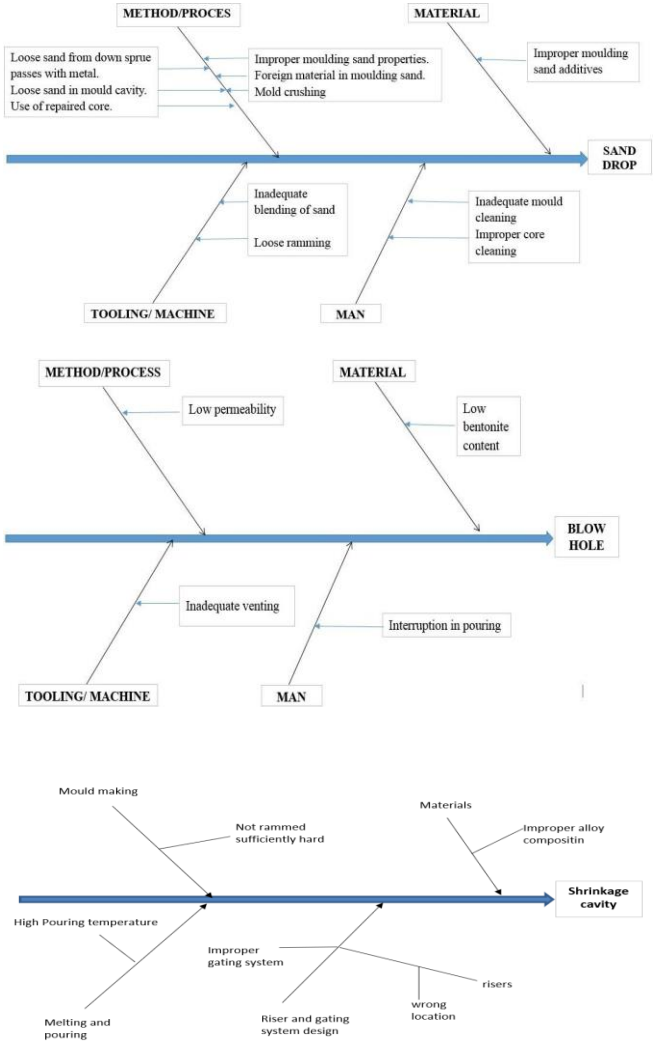


Fig2. Ishikawa diagrams for the swash plate (PVB10 Yoke)

II. For second trial:

The second trial was taken on the date 10-9-2019. For the minimize the rejections of the swash plate (PVB10 YOKE) casts through defect which is found in first trial the core (manual core) arrangement is done at the time of molding for the second trial. Core is placed at opposite side of the ingate in the drag pattern. The core tip is painted with zircon paint.

Fig3. Core Arrangement in the cope pattern at the time of molding

DEFECTS	Shrinkage porosity	Sand Fusion	Blow Hole
REJECTED QUANTITY	9	2	3

Poured Quantity	Rejected Quantity	Rejection (%)
32	14	43.75

III. For third trial:

For the minimize the rejections of the swash plate (PVB10 YOKE) casts through defect which is found in shop floor trials we decided use simulation software for the third trial.

Casting simulation technique mostly used in foundries and metal casting industries. Numerical optimization (Simulation) is the process of imitating a real phenomenon using a set of mathematical equations implemented in a computer program. Casting process simulation is now becoming a prime requirement and invaluable tool in the production of economical and high-performance cast components.

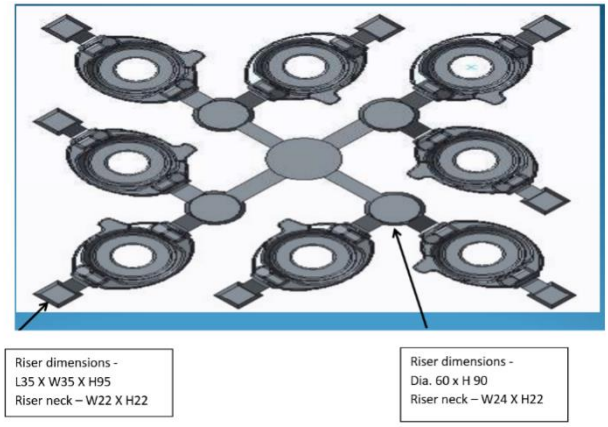
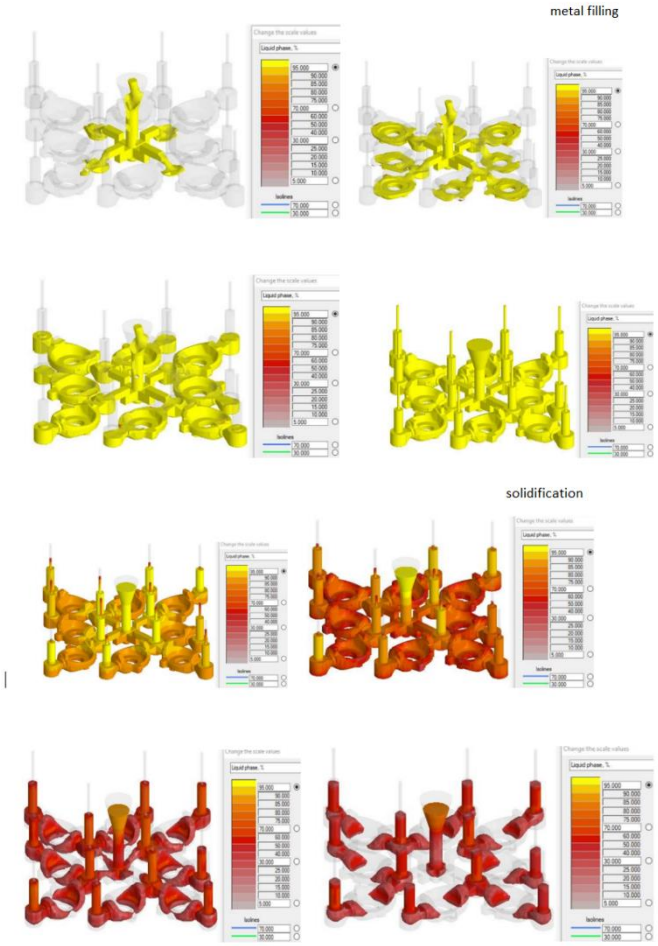
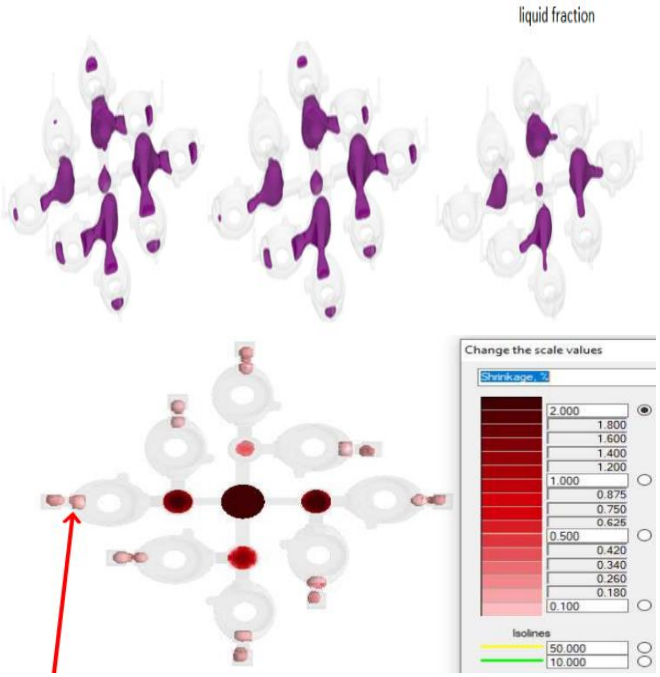


Fig4. Methoding dimensions for simulation

The shrinkage porosity defect still presents in swash plate (PVB10 Yoke). From the we not found the correct root cause of the shrinkage porosity. The next step to find the cause of defect using simulation method from the simulation method, we find the root cause of shrinkage porosity. There is different software used for the simulation like Auto cast, Click to Cast etc. here Auto cast software used for casting defect analysis.





With sand riser shrinkage found

Fig5. It is shrinkage porosity defect using Auto Cast simulation

DEFECTS	Shrinkage porosity	Sand Fusion	Blow Hole
REJECTED QUANTITY	9	2	3

Poured Quantity	Rejected Quantity	Rejection (%)
32	14	43.75

IV. For fourth trial:

For the minimize the rejections of the swash plate (PVB10 YOKE) For the fourth trial by using sleeve riser, we save the 6.25 kg metal. There are 12 number of Sleeve risers used in fourth trial and reduce the bunch weight up to 7 kg. Sleeve riser size – Fedexo 30X80(B). For experimental validation molten metal was poured in die cavity and allow solidifying at room temperature. Casting produced was free from all defects.

5.CORRECTION DONE IN DESIGN TO REDUCE CASTING DEFECT

5.1 Corrective action (Phase I)

From the three trials the main causes of defect are increase the number of sand risers and minimize the casting defect of swash plate (PVB10 Yoke).

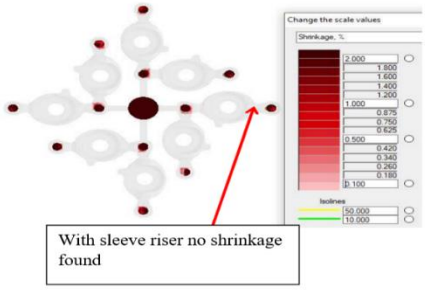
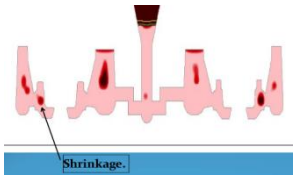
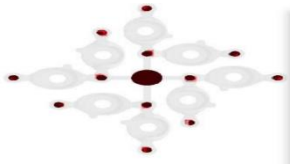
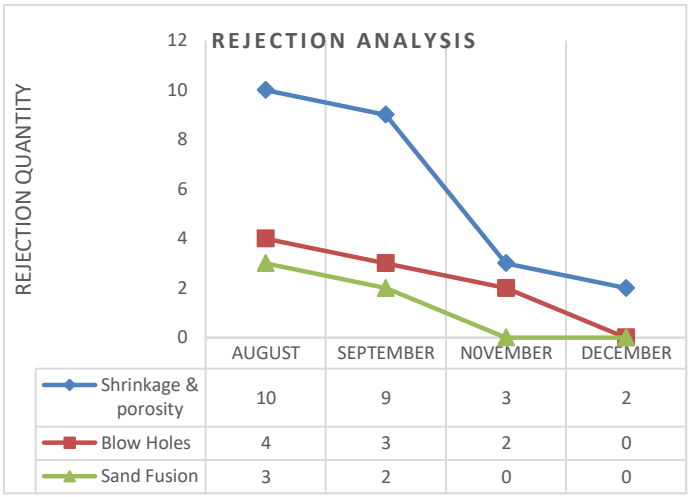


Fig1. No shrinkage found inside the casting

5.2 Difference between third and fourth trial

Third trial	Fourth trial
1. For the third trial we used sand risers.	1. For the fourth trial we used sleeve risers.
2. In the third trial shrinkage found inside the casting. 	2. In the fourth trial no shrinkage found inside the casting. 
3. With using sand risers bunch weight = 35 kg	3. With using sleeve risers bunch weight = 28.75 kg
4. With using sand risers more metal required to fill.	4. With using sleeve risers low metal required to fill. Total 6.25 kg metal save due using of sleeve risers.
5. In the third trial we used 8 no. of sand riser.	5. In the fourth trial we used 12 no. of sleeve riser.
6. 45.71% casting yield found in third trial.	6. 83.47% casting yield found in fourth trial.
7. With third trial 5 no. of casting rejected out of 40 no. of casting. Total 12.5% rejection done.	7. With fourth trial 2 no. of casting rejected out of 40 no. of casting. Total 5% rejection done.

5. RESULT AND EVALUATION



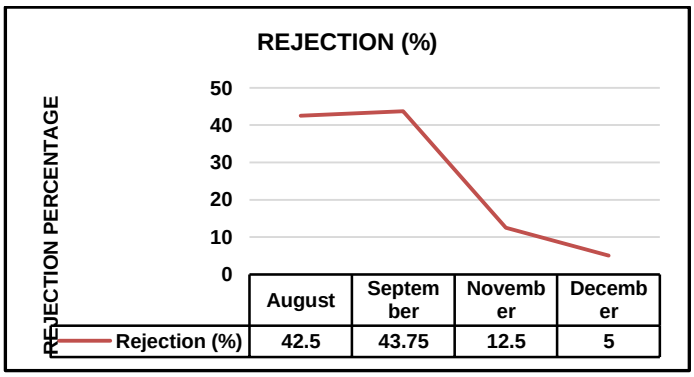


Fig 6. Rejection data of front cover in month wise

In august month major defect like sand drop shrinkage porosity, blow hole and sand drop and total rejection percentage of all defect of swash plate (PVB10 Yoke) is 42.5% for minimize the defect use statistical quality tool in we use Ishikawa diagram from which we find the root cause and taking correction action on it. The change in the sand property due which blow hole and sand fusion defect are minimize in the September month but blow hole and shrinkage porosity defect are not reduced.

In the September month we take a trial with the core (manual core) arrangement is done at the time of molding for the second trial. Core is placed at opposite side of the ingate in the drag pattern. The core tip is painted with zircon paint. And check the defect but there in not much change in the defect small percentage of defect are reduced.

In the month of November, we use simulation software. From the simulation we know the shrinkage porosity defect occur due to the riser system. in the riser system due to small size of riser metal they both solidify before the casting component hence shrinkage porosity defect

occurs; we increase the size of riser and check the defect then sand drop and shrinkage cavity defect are reduced.

From shows the rejection percentage in month wise, in the August month rejection percentage is 42.5 % using the simulation decrease the casting defect rejection percentage to 5 % from this way we reduced the rejection percentage.

6.1 CONCLUSIONS

The casting component swash plate (PVB10 Yoke) is selected for the simulation analysis because swash plate (PVB10 Yoke) has maximum percentage of rejection. The total rejection percentage of swash plate (PVB10 Yoke) in (august 2019) was 42.5 %. First shortlist the major and minor defect. It was observed that simulation software is powerful tool to predict the shrinkage defect inside the casting and machining part. It helps to predict the shrinkage porosity defect inside the casting part with reduce shop floor trial. Casting yield improves up to some percentage, and shrinkage defect is also reduced.

For the shrinkage porosity we do the Auto Cast simulation from which we notice that ingate and runner are solidify before the swash plate (PVB10 Yoke) solidify then we increase the size risers and minimize the shrinkage porosity. This all changes the reduced rejection percentage is reduced from 42.5 % to 5 %. At the end set the process parameter value for the swash plate (PVB10 Yoke).

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