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REJECTION ANALYSIS OF CASTING DEFECT USING STATISTICAL QUALITY TOOLS WITH SIMULATION

Mr. Dattatray Hajare[1], Mr. Pravin Gosavi[2]

[1]Student, KIT's College of Engineering, Kolhapur, Maharashtra, India
[2]Faculty, KIT's College of Engineering, Kolhapur, Maharashtra, India

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Abstract – *In the industry different type of casting component are produced, nowadays increasing demand of high quality casting component at right time. For the quality casting component required skill and knowledge. In small industry use trial and error technique defect analysis it is used for reduced rejection percentage of casting compound but this process is time consuming and economical and also this process has less control on rejection of casting components the main aim is produced defect free components at right time and increase the quality of casting components, In this paper used statistical quality tools and Auto-cast simulation software for finding root cause of casting defect. Ishikawa diagram, why-why analysis and brain storming this are statistical quality tool used foe rejection analysis casting. Using statistical quality tools cover defect like sand drop, sand fusion, blow hole cold shut etc. but leakage defect root cause not found using statistical quality tool. For minimize leakage defect use auto-cast simulation software find out the root cause. Taking the corrective action and reduced rejection percentage of casting defect of front cover.*

Key Words: front cover, casting defect, statistical quality tools, casting simulation, shrinkage porosity.

1. INTRODUCTION

Metal Casting process in the oldest manufacturing process for the making the metal component, in this process is very useful for manufacturing complex shape component. Metal casting process nothing but it is process in which molten metal poured into the mould cavity and allow solidifying. The casting process is very useful for the casting for production of small as well big casting component. For survive in the market produced high quality component with less time and decrease the rejection percentage.

Front cover is part of hydraulic machine this component is made for high pressure hence it sustains for high pressure without brake or leakage. For production of high quality casting component defect must be decrease. Finding root cause of casting defect use the different statistical quality tool and auto-cast simulation software, in statistical quality tools used Ishikawa diagram, why-why analysis, Pareto chart, brain storming for finding root cause. His statistical quality tools are very useful for the defect analysis. In this process used the statistical quality tool and auto-cast simulation reduced the rejection percentage of casting defect and improve the quality of casting component.

2. LITERATURE REVIEW

Avinash juriani : Studied the casting defect with a case study. These papers explained the defect of casting and also give the cause of the defect and provide remedies. This paper is identifying the casting defect and finds a primary solution it has to improve the quality of the casting component and reduce the rejection.

Siekanski and Borkowski (2003): the root cause of various non-conformities was found using the Ishikawa diagram and Pareto analysis. The paper demonstrates some basic techniques that can be used in identifying the key causes of defects in heavy industry casting process. It shows that material factors, accepted technology, and the human factor all have a significant impact on casting efficiency. The diagram of Ishikawa represents reasons responsible for the problems investigated in a complex manner - large quantities of defects are caused by material and negligence of workers and technology. Their main focus was on the defects that arise due to human error while operating. They recorded a 2 percent reduction in the current rejection percentage by correcting the human factor.

C.M Chaudhari 2014: detailed study of casting defects using autoCast software it helps to increase the casting quality of the component in which we know the defect in casting before actual casting of product. It has to reduce defect in casting directions or edification are achieved with help of proper getting system design.

Abolarin 2010: Study the molding sand property using Tuden Wada Clay as a Binder. Moisture constraint and clay are affected. The sand property for the foundry molding sand. River Niger sand is a more usable product and Tudun wada clay is alternative to bentonite for binding clay in foundry mold. The River niger sand and Tudenwada clay with proper water is suitable for alloy components in the foundry.

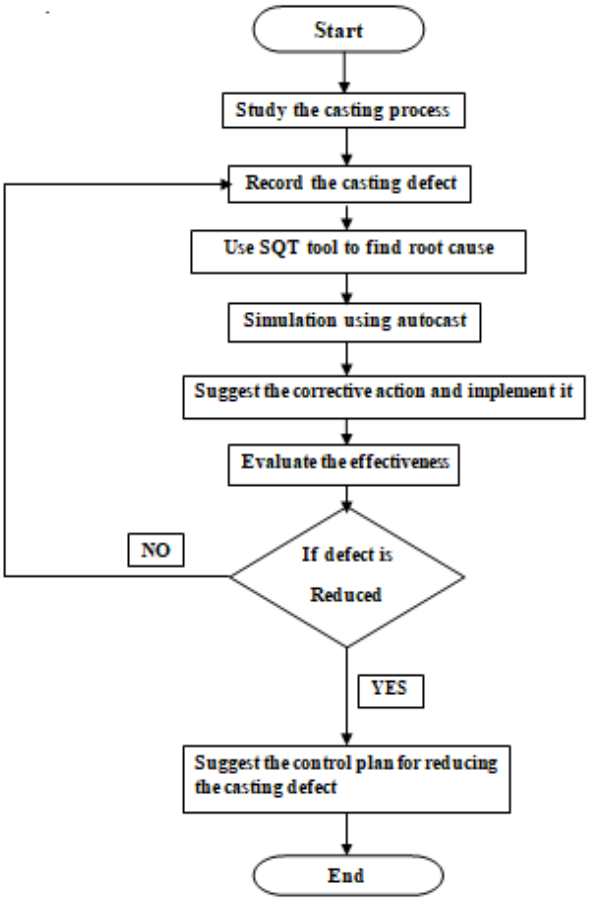
Tiedge 2011: study the different casting materials of the high-temperature metal with mold. The thermal difference and thermal shock experienced by sand. Shock leads to surface defects as scab erosion metal penetration. Burning of soil to reduce this defect coating is used. The coating is a

mixture of Binder agent suspension agent refractory filter and additives. Refractory materials that have a high melting point and also difficult trace silica flour olivine graphite example of counting material. Spraying flow casting and append this is the coating method.

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 front cover

First study the casting defect found in the front cover. There are four major defects occur in front cover which is sand drop, shrinkage porosity (leakage), sand fusion and blow hole study this defect in detail.

DEFECTS	Sand Drop	Shrinkage porosity	Sand Fusion	Blow Hole
REJECTED QUANTITY	176	133	108	55

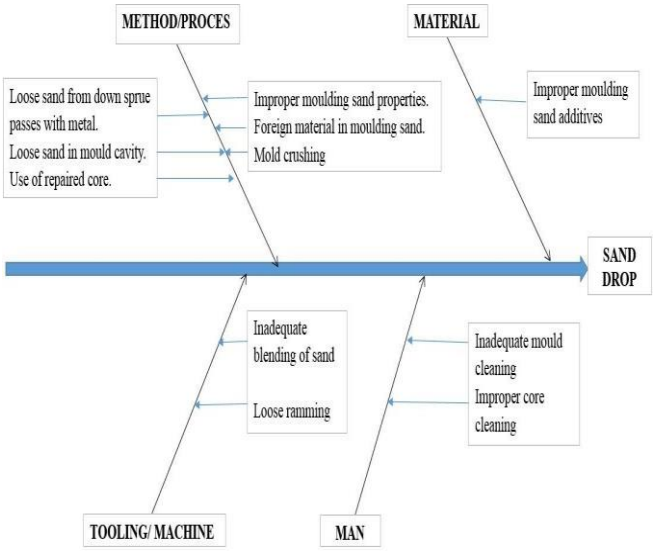
Poured Quantity	Rejected Quantity	Rejection (%)
5328	540	10.14

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 the defect in front cover

Ishikawa diagram is useful for finding root cause casting defect, Ishikawa diagram also know as fish bone diagram. Fishbone diagram find the step wise analysis of root cause, defect show to word the right end and cause are extending left as a fishbone. The ribs branch of the backbone used for the major causes and sub-branches for the root cause Fishbone diagram used when identifying possible cause for the problem.



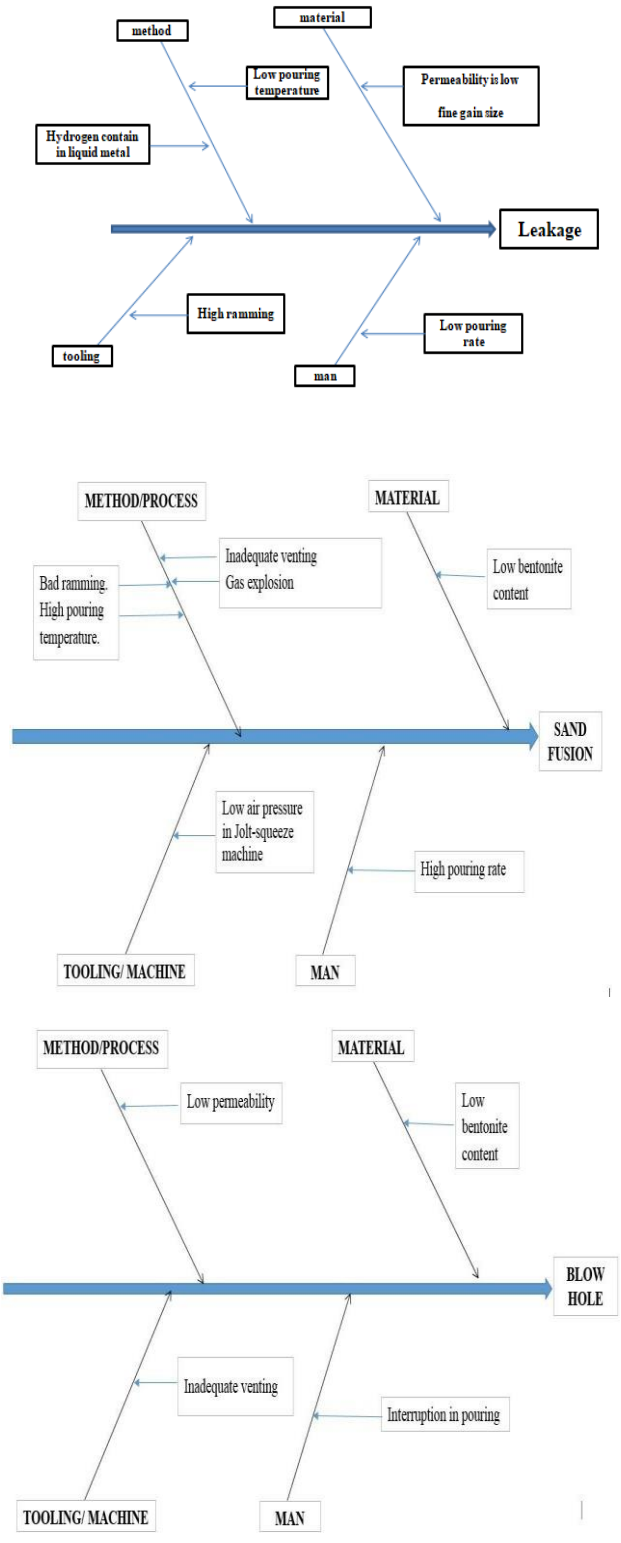
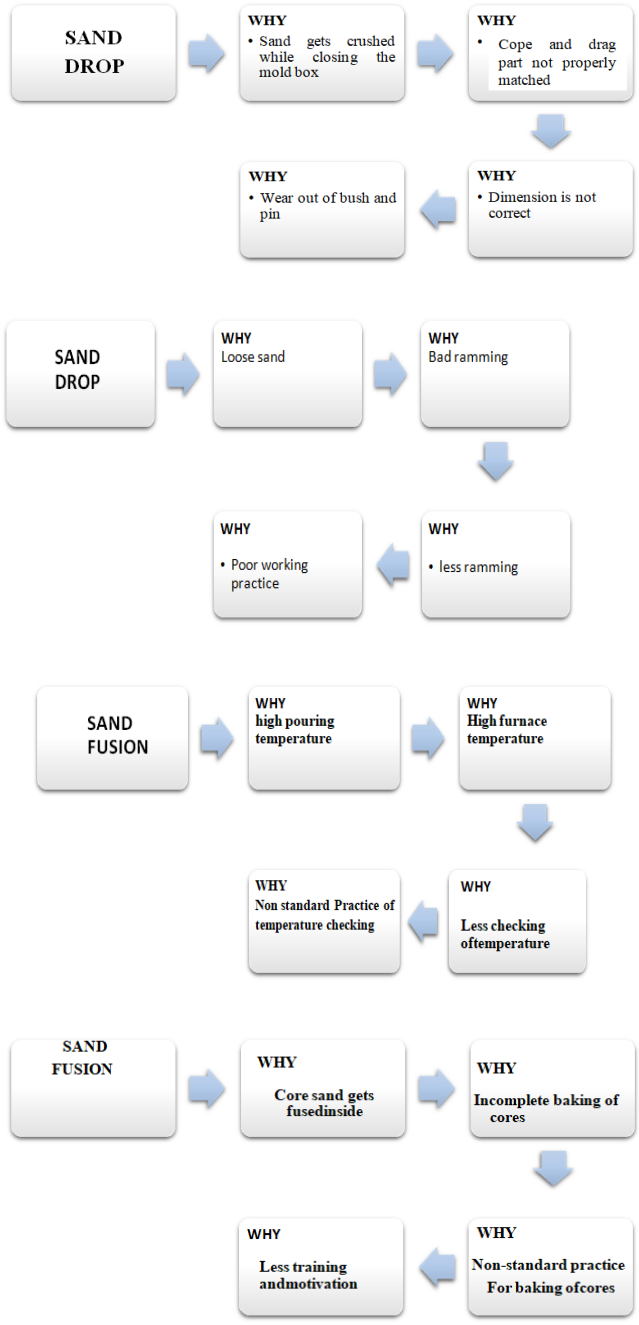


Fig1. Ishikawa diagrams for the defect Sand front cover

II. Why-Why analysis for the defects in front cover

The Why-Why analysis is a technique in which asking the question why again and again of to which we cannot find the root cause. Find the problem and ask the question why to the problem and find the answer and again ask question to the answer this process continuous up to which finding the root causes.



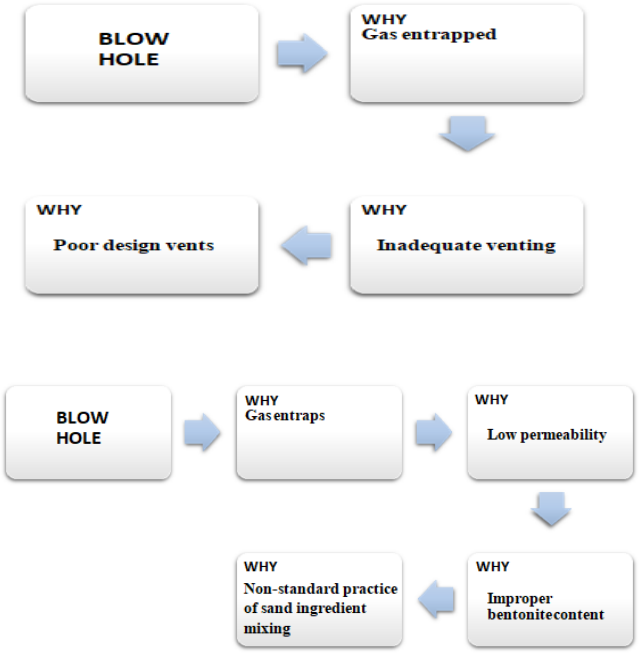


Fig2. Why-Why analysis for the front cover

III. Brain Storming for Sand drop defect

The brain storming is technique in which different expert of each department coming together and discus on problem and solution. For the casting process quality head, foundry head, pattern head, like that each department come together with department problem and solution. The main purpose is finding the root cause of defect.

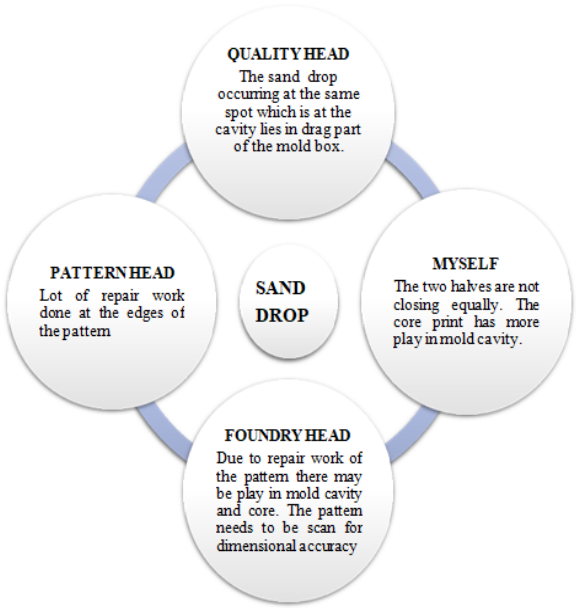
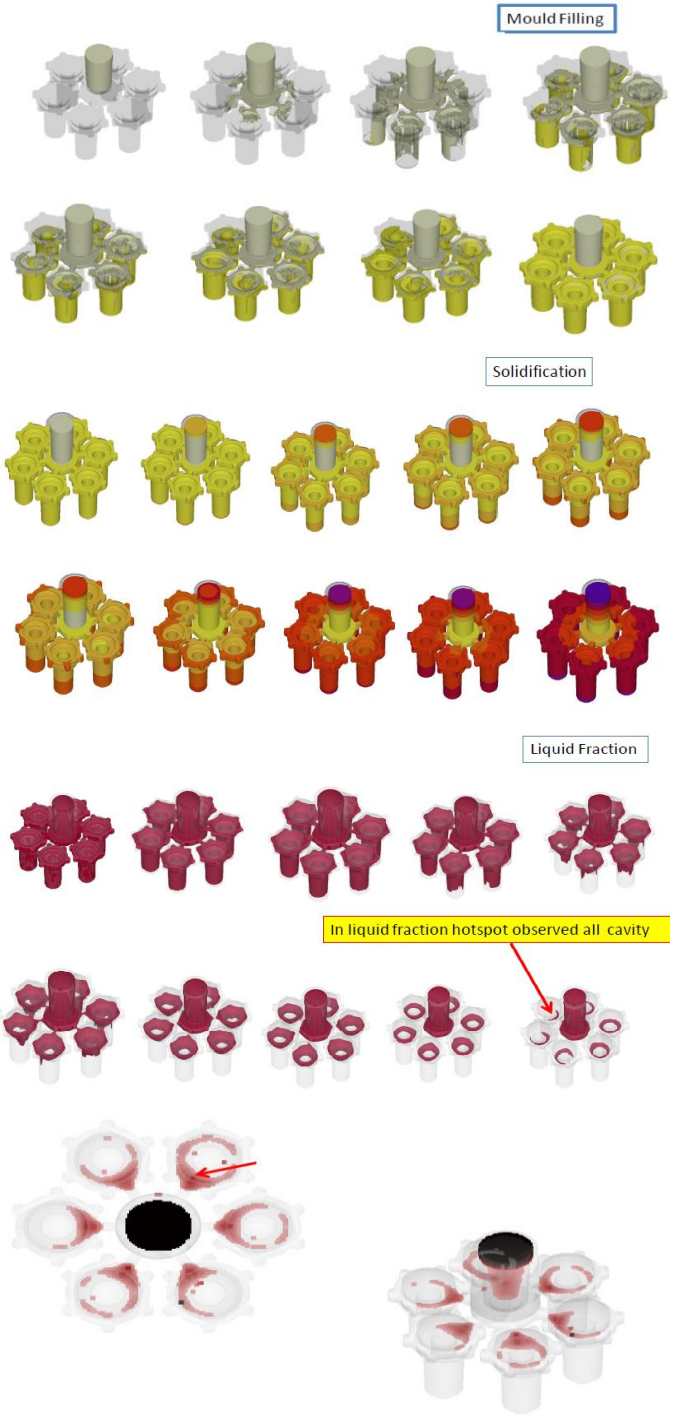


Fig3. Brain Storming for Sand drop defect

IV. Defect analysis of shrinkage porosity using Auto Cast simulation

The shrinkage porosity defect still present in front covers. From the statistical quality tools 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.



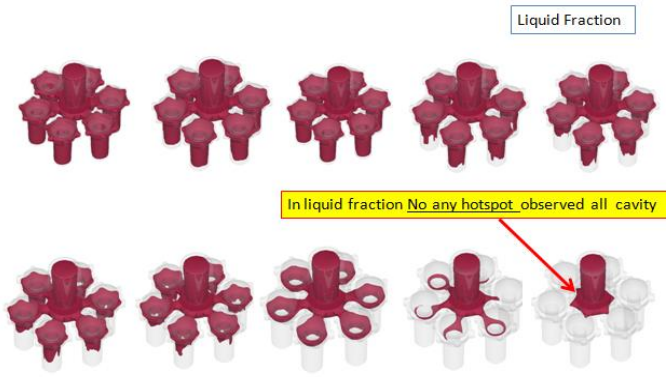


Fig4. It is shrinkage porosity defect using Auto Cast simulation

5. CORRECTIVE ACTION TAKEN TO REDUCE CASTING DEFECT

5.1 Corrective action (Phase I)

From the analysis of Ishikawa diagram the main causes of defect is molding sand and its property hence the change in sand and its property and minimize the casting defect of front cover.

Sand property	Observed	Required
Green compression strength	1050 gm/cm2	1000 to 1200 gm/cm2
Moisture Content	3%	3 to 3.5 %
Permeability	120 nos.	135 to 145 nos.
Compatibility	35 nos.	40 to 45 nos.

For the better property of sand use fresh sand, when increase the fresh sand casting defect are decreases defect like sand fusion sand drop blow hole this defect occur due to the improper mixing of fresh sand.

For the properly mixing of sand and increase the property of sand here take 190 kg used sand and 10 kg of fresh sand adding .8 kg of coal dust and 2.2 kg of bentonite with 6 % of water and mix it properly.

5.2 Corrective action (Phase II)

From the why-why analysis found that the root cause of defect occurring in the front cover is due to lose bonding between bush and pin and improper poring temperature.

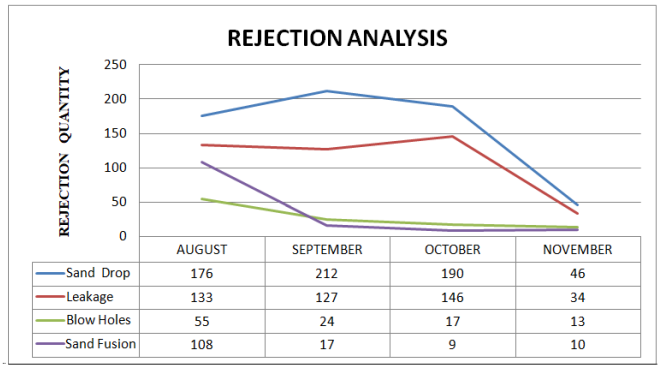
Temperature at mould box is controlled around 1400 ^{0}c and bush is accepted between the range of 19.000 to 19.030 and pins are accepted between the range of 18.920 to 18.950.

5.3 Corrective action (Phase III)

After inspecting the pattern, the pattern has seen a lot of maintenance work done to on it. As seen and noted the pattern must be tested for dimensional consistency.

Gating system is very important in casting process. It should be perfect. Here the size of gating system is main cause of shrinkage porosity defect know from the Auto cast simulation. If the size of runner and Ingate increase then the shrinkage porosity defect is minimize. The size of runner and Ingate is 15*12*20 and changed dimension is 30*32*30

6. RESULT AND EVALUATION



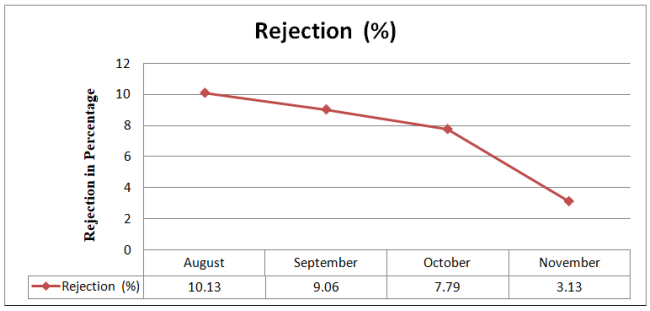


Fig4. Rejection data of front cover in month wise

The front cover is selected for the rejection analysis because this component has major percentage of casting defect. From the fig. 5.1 and 5.2 it shows that in august month major defect like sand drop shrinkage porosity, blow hole and sand fusion and total rejection percentage of all defect of front cover is 10.14% 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 sand drop and shrinkage porosity defect are not reduced.

In the October month using the why-why analysis finding the root cause of this defect. From the why-why analysis we observed that defect occur due two there is no control on the temperature and flow rate and other is wear out of bush and pin. Hence we fix the temperature value flow rate and changing the wear of bush and pin. 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 brain storming and simulation software. From the brain storming we found the root cause of for sand drop defect is wear out the pattern and wear out of bush and pin we change the size of pattern and changing the wear out bush and pin. And from the simulation know the shrinkage porosity defect occur due to the gating system. in the gating system due to small

size of runner and ingate metal they both solidify before the casting component hence shrinkage porosity defect occur, we increase the size of runner and ingate and check the defect then sand drop and shrinkage cavity defect are reduced.

From the fig. 5.2 it show that the rejection percentage in month wise, in the August month rejection percentage is 10.14 % using the statistical quality tools and simulation decrease the casting defect rejection percentage to 3.13 % from these way we reduced the rejection percentage

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6. CONCLUSIONS

The casting component front cover is selected for the rejection analysis because front cover has maximum percentage of rejection. The total rejection percentage of front cover in (august 2019) was 10.14 %. First shortlist the major and minor defect. The casting defect occurs due to the incorrect the process parameter value, the root cause of this defect is found with help of statistical quality tools. With help of this we found the relation between process parameter and casting defect and according to which process parameter value is selected and minimize the casting defect

The defect like blow whole, sand fusion is reducing with help of statistical quality tools. And suggest the solution but sand drop and the shrinkage cavity this defect are not minimize, then use brain storming for sand drop, from which found that the pattern are wear out and green sand strength are low, after we change the pattern and increase the strength of sand.

For the shrinkage porosity we do the Auto Cast simulation from which we notice that ingate and runner are solidify before the front cover solidify then we increase the size ingate and runner and minimize the shrinkage porosity. This all changes the reduced rejection percentage is reduced from 10.14% to 3.13 %. At the end set the process parameter value for the front cover.

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