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Experimental Investigation on Reducing the Quality Concern of Blow-Hole In Cylinder Block

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***Abstract*:- In this research paper an Automotive component having Blow–hole defect has been taken. The said component is an Automotive 3-Cylinder engine block with displacement of 799cc. since it is the important component it has to be of the higher quality so there is no room for shortcuts. In this paper various analysis of part is done using Quality Control tools (QC Story). In order to be efficient and effective we follow Plan-Do-Check-act (PDCA) cycle for identifying the optimum process parameter in order to improve the casting quality and reduce the rejection rate at factory end. From the Pareto chart and Cause & Effect diagram, the major causes are prioritized and controllable factors identified.**

Keywords: Blow-hole, QC Story, Pareto chart, Cause & Effect diagram, PDCA.

1. INTRODUCTION

Die casting process is a process used in order to manufacture complex shapes. Cylinder block is made of High Pressure Die Casting (HPDC). Defect rate in casting process increase the loss of production time and cost to the company. In this paper, we going to solve the real time problem faced by one of the manufacturing company. The major defect identified is Blow-hole near gating area. This Blow-hole leads to major leak in the casting. Blow-hole is found after machining of 2mm in Cylinder block. The defects were identified by past production lots and reports provided by the quality department. The Blow-hole defect can be minimized by taking precautionary measures in casting process. Blow-hole in the Cylinder block leads the casting to scraps.

The manufacturing company is Automotive MNC company, here they are facing high rejection rate in Cylinder block, failing to deliver the required quantity on time.

Fig 1, shows the foundry stage PPM rejection trend plotted for the months of Sep-Nov FY'18. The gap in Sep is 2000 PPM, in Oct is 3706 PPM, in Nov is 4529 PPM. The overall average PPM for a period of Sep-Nov FY'18 is 13,500 PPM. The actual rejection PPM doesn't meet the target PPM even in a single month. Hence it seemed like a chronic problem.

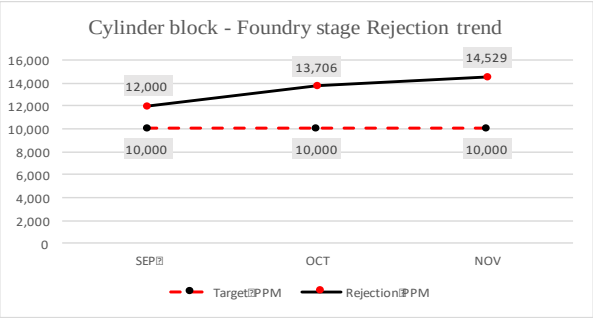

Fig 1: Foundry stage rejection trend.

	Sep'18	Oct'18	Nov'18	Average Total
Inspected in no's	17,000	17,000	17,000	17,000
Scrapped in no's	210	233	247	230
Rejection in PPM	12,000 PPM	13,706 PPM	14,529 PPM	13,500 PPM

Table 1: Rejection trend table.

2. METHODOLOGY FOR BLOW-HOLE ANALYSIS

QC Story is a methodology in Total quality management (TQM), which is intended to solve a problem. QC Story is based on the principle of Plan-DO-Check-Act (PDCA). Generally, a Qc Story is a 7 steps procedure, but elaborated to 9 steps for better efficiency.

First all the rejection data of casting is collected from the quality department. Then by using the QC tools such as Pareto chart and Cause & effect diagram the work is carried out. Fig 2, shows the QC story procedure

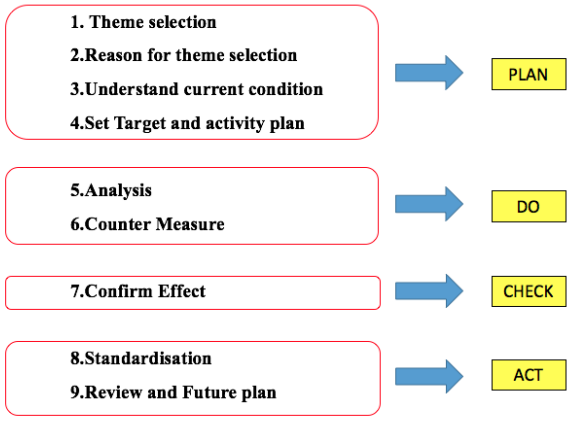

Fig 2: QC Story procedure.

2.1 Pareto Chart

The Pareto analysis of cylinder block was carried out for the period of 3-months from September-November FY'18. It is inferred that Pareto analysis prioritizes Blow-hole defect as top priority contributing to 65.36% of overall defects, followed by oil leak, water leak and others being 17.97%, 10.29% and 6.38% respectively. Fig 3, shows the defect rate for the 3-months.

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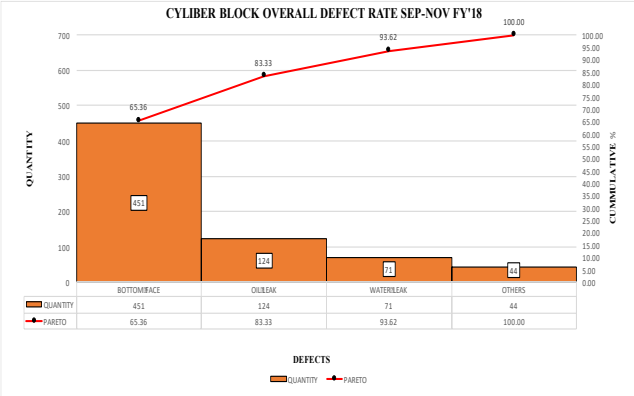

Fig 3: Overall defect rate September-November FY'18

Data collection was done to know about the current scenario of the rejection trend of the component and then it was further segregated to know major error producing area and then that data was converted into Pareto chart. Fig 4, shows the location wise Blow-hole defect for 3-months September-November FY'18.

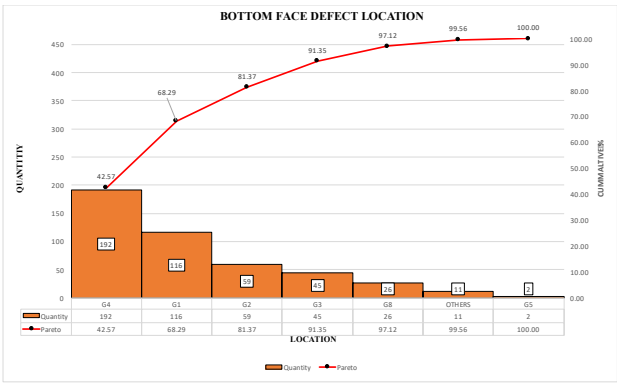

Fig 4: Location wise Blow-hole defect Sep-Nov FY'18.

2.2 Cause & Effect diagram

The various causes for Blow-hole defect was found using Brain storming, significant reasons were identified. The systematic methodical approach is being devised for controlling the defect rate.

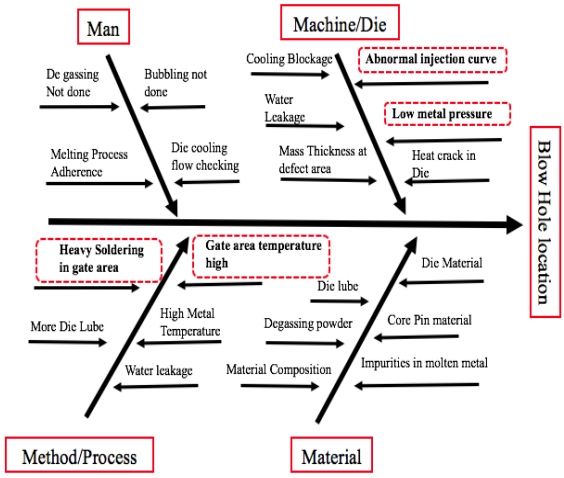

Fig 5: Cause – effect diagram.

Cause – effect diagram is one of the approaches to enumerate the possible causes. Fig 5, shows the cause-effect diagram with significant problem.

3.DATA MEASUREMENT PLAN

Process/ Input	Operational definition	Data source & location	Sample size	Who will collect the data
Abnormal injection curve.	To investigate the effect of process parameter setting.	Daily testing parameter report.	10 samples from a lot.	Technician.
Low metal pressure.	Temperature taken at "Spout of press pour" at which a casting metal is poured.	Daily testing parameter report.	2-3 times in a single lot.	Technician.
Soldering mark in defect location.	Observed from the Cylinder block casting.	Daily log sheet.	2-3 times in a single lot.	Technician.
Gate area temperature high.	Temperature taken at gate area of the casting.	Daily testing parameter report from the lab.	2-3 times in a single lot.	Technician.

Table 2: Data measurement table.

Table 2, shows the data measurement plan for the performance measure such as Abnormal injection curve, Low metal pressure, Soldering mark in defect location, Gate area temperature high. Data source, sample size, data collection techniques are indicated.

4.ACTION TAKEN

Fig 6: Blow-hole defect cut piece.

As shown in the above fig 6, the blow-hole was found at the gate area location on the Cylinder block casting. G1 and G4 gate location was found Significant and the root cause of the problem was identified.

The corrective action was taken in the die since the cooling is insufficient at defect location. The temperature at G1 and G4 was high and it corrected by increasing the depth of cooling points in the die.

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	Diameter	Depth
Before	8 diameter	165mm
After	8 diameter	190mm

Table 3: Change in Die measurement

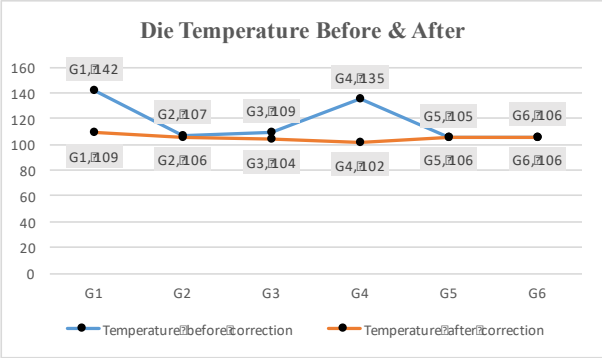

Fig 7: Temperature Before & After Correction in Die.

5.PROJECT RESULT

The Blow-hole defect analysis was carried out using QC tools and the 3-month data was collected from the log sheet available at the company. Using that the rejection trend was found and the Blow-hole contributes about 65.36% defect rate from all other defect. So the significant cause was found and corrected.

Fig 8, shows the Rejection trend for the of January-February FY'18. The Blow-hole defect rejection rate is reduced. The target achieved is 0.94%.

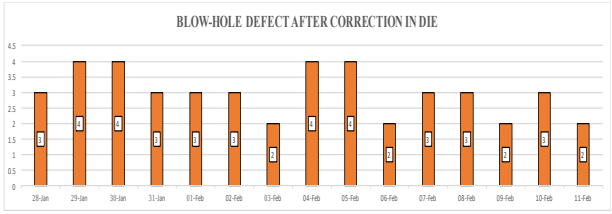

Fig 8: Rejection trend of January-February FY'18.

5.1 Cost benefit analysis

Current level of Blow-hole	1.35% (Average of 3 months)
Achieved level of Blow-hole	0.94%
Reduction in defects	0.41%
Production plan / month	17.000 no's
Number of rejection / month	160 no's
Cost saving / month	7.68,000

Table 4: Cost benefit analysis

6.CONCLUSION

The main objective of the project work is to reduce the Blow-hole defect rate in Cylinder block manufacturing thus the defect rate reduced drastically from 1.34% to 0.94%. The profitability for the foundry was increased directly by over coming the Rejection rate of Blow-hole.

7.REFERENCES

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