TO REDUCE THE REJECTION IN THE FORM OF BLOW HOLES IN FOUNDY INDUSTRY

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ABSTRACT

The present paper deals with the reduction of rejection due to casting defects in a foundry industry. The industry is making cast iron castings of submersible pumps components such as Upper housing, Motor Pulley, Mini Chaff cutter wheel in large scale and having rejection in the form of Blow hole .The three important part of industry were chosen for complete analysis. The improvement in these defects can be done by the application of DMAIC approach. The study was done at HARYANA(India) on application of Six Sigma methodology and Selection of tools and techniques for problem solving, because of its high rejection rate. The results achieved show that the rejection due to sand casting defects has been reduced the cost .

Keywords: Reduction, Defects, Casting, Housing, Mini Chaff, Blow hole, Motor pulley.

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INTRODUCTION

DMAIC refers to a data-driven improvement cycle used for improving; optimizing and stabilizing business processes.The DMAIC technique is an overall strategy to accelerate improvements in its processes, products and services. This approach is a project driven management approach to improve the organization products, services and processes by continually reducing defects in the organization. It is a powerful improvement business strategy that enables companies to use simple and statistical methods for achieving and sustaining operational excellence. DMAIC approach differs from other quality programs in its top down drive in its rigorous methodology that demands detailed analysis fact based decisions. It is a rigorous data driven method for dealing with defects, waste and quality problems, in manufacturing, services and other business activities. This approach is an upcoming quality improvement process and is proving to be a powerful tool for solving complex problems. It would not work well without full commitment from upper management .It is a scientific method to improve any aspect of a business, organization process.

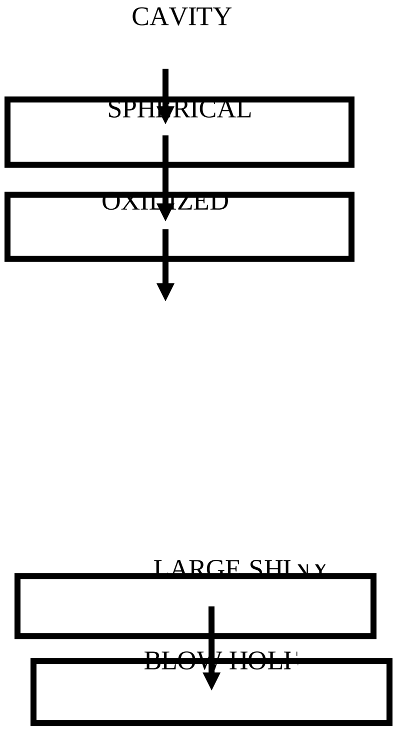
METHODLGY

In this process, a pattern is made in the shape of the desired part. The pattern can be made of wood, plastic, or metal. Simple sand castings can be made in a single or solid pattern. More complex designs are made in two parts, called split patterns. The pattern is then packed into sand, mixed with a binder and removed, leaving a hollow space in the sand in the shape of the desired part called mould.The pouring temperature of the material should be a few hundred degrees higher than the melting point of the material to assure good fluidity, thereby avoiding premature cooling, which can create voids and porosity. The mixture of sand and clay is moistened with water to develop strength and plasticity of the clay to make the aggregate suitable for molding. The term Sand Casting can also refer to a casting produced via the sand casting process. Sand castings are produced in specialized factories called foundries. Over 75% of all metal castings are produced via a sand casting process. In modern foundries, green sand molding method is widely used for small size automotive castings. It is the least expensive method and gives optimum quality due to low cost of sand and its ingredients and its reusability for further production.Sand casting process is shown in Figure1.1. A solid shape of the required object is made (known as the pattern). Sand is then rammed around the pattern in a 'Moulding box'. When the pattern is removed it leaves a shaped cavity behind. The runners (where the fluid is poured in) and risers (where excess fluid can escape) also act as reservoirs of liquid to top up the casting as the metal contracts on cooling. The process can be used to make hollow castings. To do this, 'cores' are inserted into moulds to produce shapes that would be difficult or impossible to make by just using a pattern.The mould is destroyed when the solid casting is removed. The surfaces of the castings produced by this method tend to be rather rough, even though quite fine-grained sand is used for the moulds. So some machining of the surface is generally required before a finished product is made. The runners and risers need to be removed.

Fig. 1.1 Picture of the Sand-Casting Process

DEFINE PHASE FOR BLOW HOLES:

These are smooth walled rounded, flattered or elongated cavities in the castings. When the cavities holes inside the casting are known as Blow holes. These are caused moisture left in the mould and core. Because of the heat of molten metal moisture is converted into steam and entrapped inside the casting, which and up as Blow holes**.**



Detection method of Blow holes

Type of defect	**Detection**	**Appearance**
Blow holes	Visual method	Rounded holes

Flow Chart of Blow Holes Defect

Picture of Blow holes

MEASUREMENT PHASE FOR BLOW HOLES:

First to collect the data of rejection in blow holes. The data collected four months and find out the defects in Blow holes. I have collected four months data in industry. I found that the rejection in blow holes is 8.39% for upper housing and total data for upper housing is given below in table , the rejection in motor pulley is 7.76% is given in and rejection in mini Chaff cutter wheel / hand wheel is 5.11% is given in table.

Data collection (before improvement) – UPPER HOUSING

Total production of four month = 2037, Total rejection of Blow holes = 171, pieces % of rejection = 171/ 2037 = 0.08394 x 100 = 8.39%

Month	Production pieces	Rejection Pieces	Blow holes defects
Sep. 2011	510	98	43
Oct.2011	505	96	41
Nov.2011	514	101	44
Dec. 2011	508	99	43
Total	2037	394	171

Month	Production pieces	Rejection Pieces	Blow holes defects
Sep.2011	1002	180	82
Oct. 2011	1005	181	77
Nov.2011	1011	182	79
Dec.2011	1000	180	74
Total	4017	723	312

Data collection (before improvement) – MOTOR PULLEY

Total production of four month = 4017,

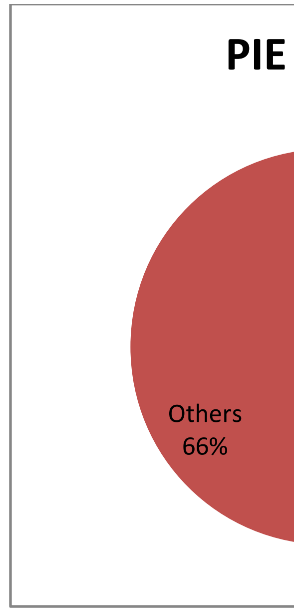
Total rejection of Blow holes = 312, pieces % of rejection = 312/ 4017 = 0.07766 x 100 = 7.76%

Data collection (before improvement) – Mini Chaff Cutter Wheel /Hand wheel

Total production of four month = 20023, Total rejection of Blow holes = 1023 pieces % of rejection = 1023/ 20023 = 0.0511 x 100 = 5.11%

Defects	No. of defective pieces	Percentage of rejection
Blow holes	1757	1757/26077= 0.0674 x 100 = 6.74%

Month	**Production pieces**	**Rejection Pieces**	**Blow holes defects**
Sep.2011	5004	828	251
Oct. 2011	5007	831	259
Nov.2011	5003	825	258
Dec.2011	5009	829	255
Total	20023	3313	1023



Pie chart for Blow holes defects rejection

IMPROVE PHASE FOR BLOW HOLES DEFECTS:

Improvement in blow holes defects: The root factors for blow holes defects were high moisture and low permeability. The industry was using 100% of reuse sand. After performing the test with 100 kg of sand sample, it was found that percentage of moisture was high and percentage of permeability was low. Therefore to reduce the blow holes defects it was necessary to increase the percentage of new silica sand to reduce the moisture and adding the permeability. The different results have been obtained by adding the new silica sand as below.

S.N	**Addition of new silica sand**	**Moisture**	**Permeability**

1	5 %	5.71 %	139 cc / min
2	5.5 %	5.09 %	156 cc / min
3	6 %	4.72 %	174 cc / min
4	6.5 %	3.87 %	189 cc/ min

Percentage recorded of moisture and permeability

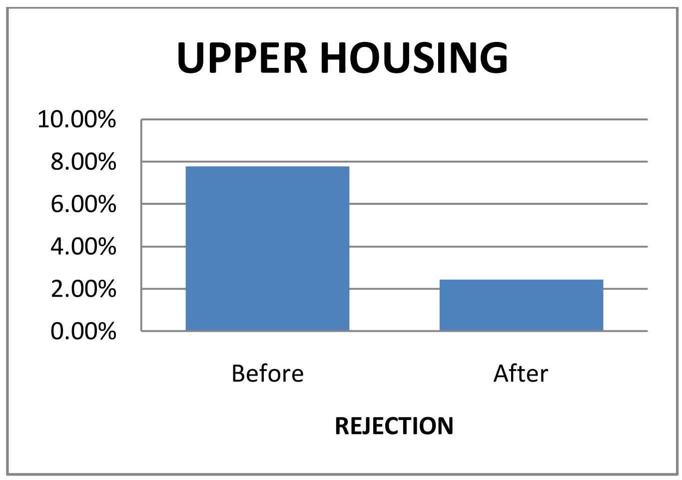
Moisture content has been reduced in the sand by adding new sand from 5% to 6.5%. So these results in reduction of moisture contact and permeability have been increased. After testing the sand the following results were obtained which were in comparison with the standard results towards achievements of reduction of sand casting defects.

After implementation of these improvements, the data of the company was collected again.

Data collection (after improvement) – Upper Housing

Month	Production pieces	Rejection Pieces	Blow holes defects
Feb.2012	503	30	13
March 2012	507	33	14
April 2012	504	31	13
May 2012	512	35	15
Total	2026	129	55

Total production of six month = 2026, Total rejection of Blow holes =55 pieces % of rejection =55 / 2026 = 0.0271 x 100 = 2.71%



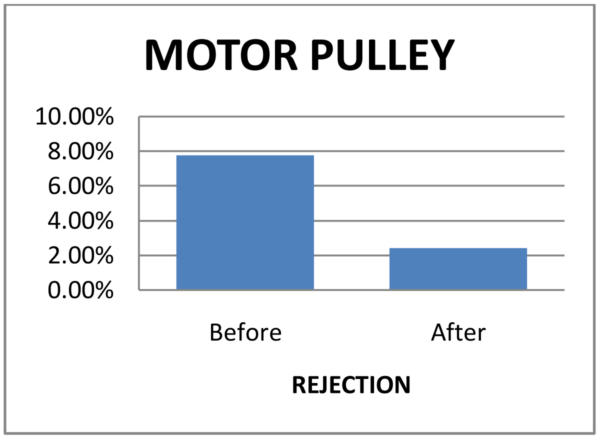
Bar chart for Upper housing

Data collection (after improvement) – Motor Pulley

Month	Production pieces	Rejection Pieces	Blow holes defects
Feb.2012	1010	56	24
March 2012	1013	59	26
April 2012	1006	58	25

May 2012	1002	55	23
Total	4031	228	98

Total production of four month 4031, Total rejection of Blow holes =98 pieces % of rejection =98 / 4031 = 0.0243 x 100 = 2.43%



Bar chart for Motor pulley

Total rejection data of blow holes

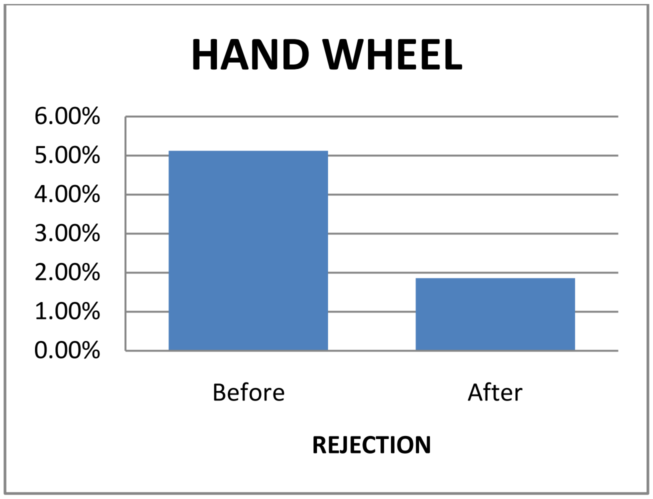
Data collection (after improvement) – Mini Chaff cutter wheel / Hand wheel

Defects	**No. of defective pieces**	**Percentage of rejection**
Blow holes	524	524/26091= 0.0201 x 100 = 2.01%

Month	**Production pieces**	**Rejection Pieces**	**Blow holes defects**
Feb.2012	5012	303	91
March 2012	5005	299	93
April 2012	5009	302	90
May 2012	5008	303	97

Total	20034	1207	371

Total production of four month = 20034, Total rejection of Blow holes =371, pieces % of rejection = 371/ 20034= 0.0185 x 100 =1.85%

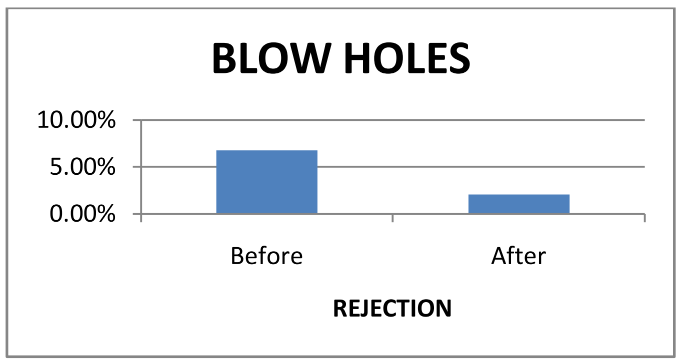


Bar chart for Hand wheel/ Mini Chaff cutter wheel

Improvements in rejection

So after the complete analysis it was found that rejection in Blow holes defects has been reduced.

Defects	Before improvement	After improvement
Blow holes	6.74%	2.01%



Bar chart for Blow holes defects

So after the complete analysis it was found that rejection due to Blow holes defects has been reduced

CONTROL PHASE FOR BLOW HOLES DEFECTS

The main objective of control phase is make to sure that the improved process stays in control after the solution. The control stage is last and final stage of DMAIC. After the study of Blow holes in foundry unit the following recommendations are made to control the reduction of Blow holes defects of submersible pumps parts. Control the permeability of moulding sand. Control the moisture content of moulding sand

Overall analysis of Blow holes after applying DMAIC process

Month	Type of defects	Number of defect	Percentage of defect	Factor	Result	Suggestions
Feb-May(2012)	Blow holes	554	2.01 %	Moisture (3.5-4.6) % Permeability (140-220)cc/min	High satisfaction	Control moisture and permeability

If the above recommendation are implemented in sand casting defects are likely to be reduced.

RESULTS AND DISCUSSION

Total rejection data (After improvement)

From the result of the application of DMAIC approach in the foundry shop the following results

Defects	No. of defective pieces	Percentage of rejection
Blow holes	524	524/26091= 0.0201 x 100 = 2.01%

were obtained.The rejection due to Blow holes defects were reduced from 6.74% to 2.01%by reducing the moisture and increasing the permeability of sand..

CONCLUSIONS

The DMAIC approach is a viable solution to their shop floor problems. This case study has substantiated the fact that many defects of sand casting can be overcome by adopting this approach. A number of experiments are carried out to validate the results which indicate that the cost of experimentation will be less, in comparison to the gain or profit of the company.DMAIC has been considered as an approach to improve quality of product and process. Reduced rejection of industry. The DMAIC approach provides a suitable visible road map for entire work force to achieve new knowledge. Accuracy of this approach is very high.

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