COST ANALYSIS OF FOUNDRY INDUSTRY IN FORM OF MISRUN BY USING SIX SIGMA

Bhupinder Singh*

Vikas Kumar**

Pradeep Kumar***

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 Misrun .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 from 16.96% to 5.99% which saved the cost of Rs. 13339/-monthly(for continuous four months), in a turnover of 45 lakhs.

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

*Assistant Professor (Med),Grimt Radaur (Ynr)

**M.Tech, Hec,Jagadhari (Yamunanagar)

***Assistant Professor (Med),Niilm University(Kaithal)

INTRODUCTION

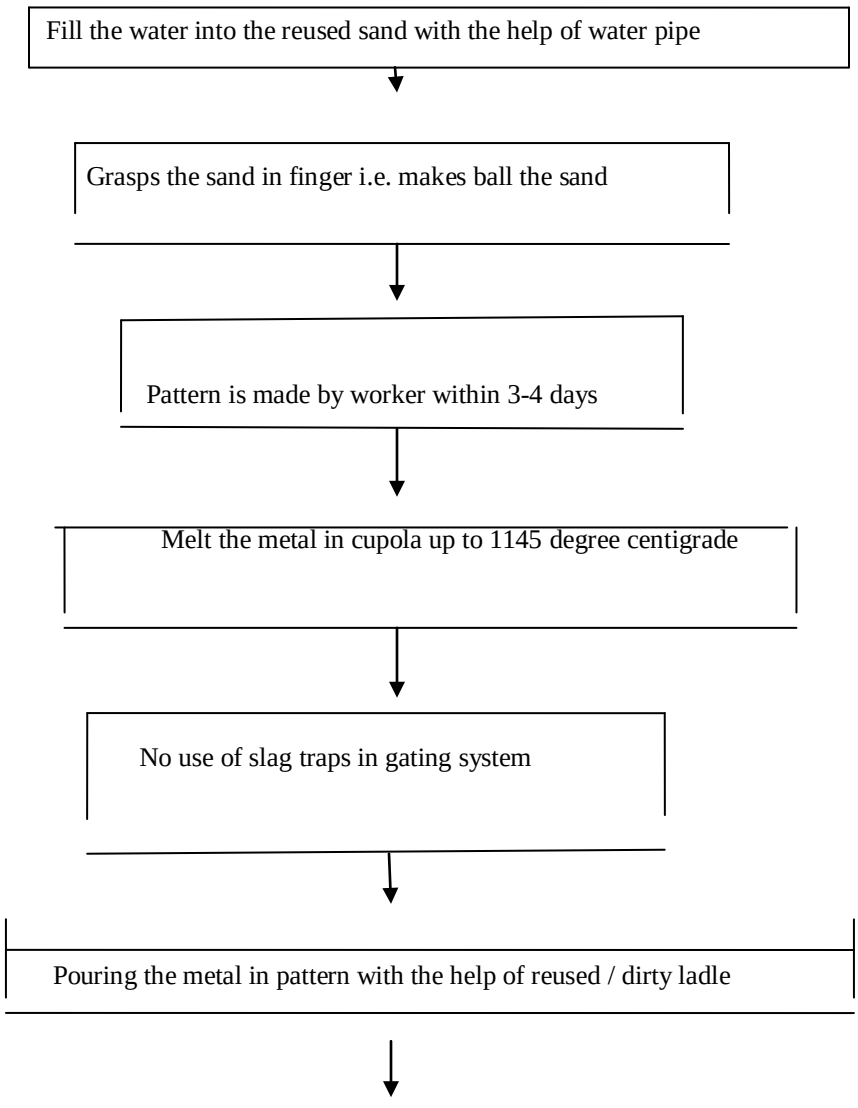
Six sigma is an overall strategy to accelerate improvements in its processes, products and services. It is also a measurement of total quality to let the company know how effective it is in eliminating defects and variations from its processes. It encompasses tools from all improvement initiatives, including those in operational, technical and customer excellence. It just applies to every function in the company, not just the factory floor. Six sigma is a quality improvement programme with a goal to reduce the number of defects. The goal of a six sigma quality programme is to improve customer satisfaction through reducing and eliminating defects and to continuously improve processes thereby improving quality and productivity.Six sigma is more than a quantitative statistical measure of processes; it embraces every aspect of work, using a disciplined, fact based approach to problem-solving. It is a new way of thinking about work and customer value. It is also a powerful force to create one corporate culture, some of it is bureaucracy busting-pushing down decision-making to lowest practical levels, empowering employees.

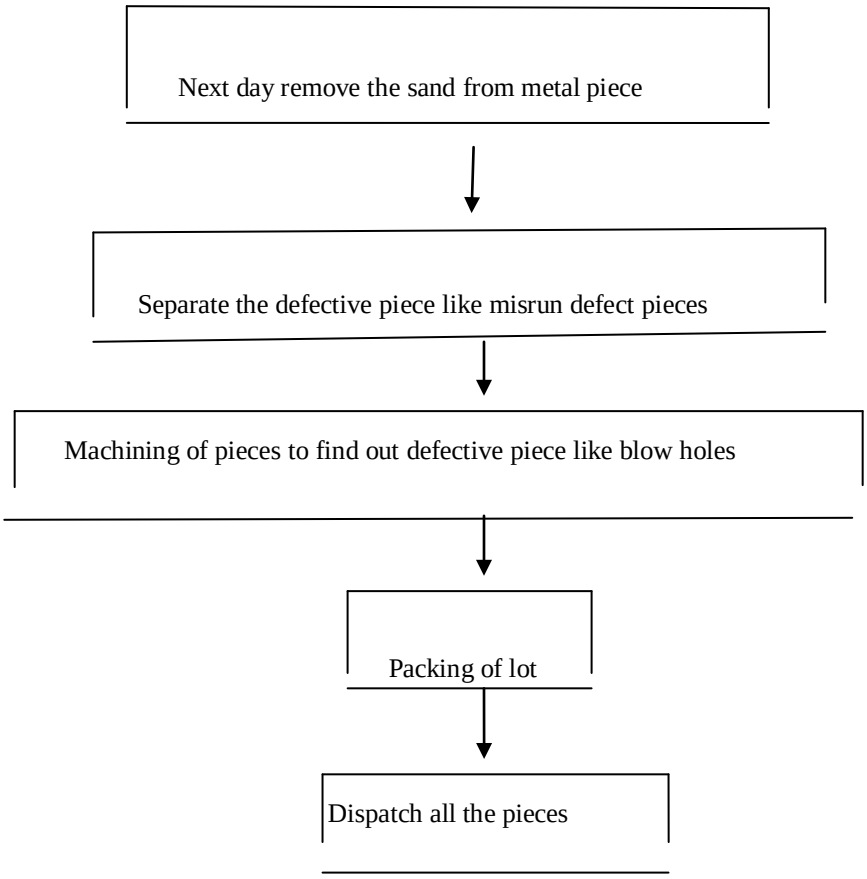
METHODLOGY

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 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.

PROCESS USED





Flow chart before improvement of ABC industries

MEASUREMENT PHASE FOR MISRUN

First to collect the data of rejection in Misrun. The data collected four months and find out the defects in Misrun. I have collected four months data in industry. I found that the rejection in Misrun is 3.24% for upper housing and total data for upper housing is given below table 5.2.2, the rejection in motor pulley is 4.01% is given in table 5.2.3 and rejection in mini Chaff cutter wheel / hand wheel is 4.49% is given in table

Data collection (before improvement) – UPPER HOUSING

Month	Production pieces	Rejection Pieces	Misrun defects

Sep. 2011	510	98	16
Oct.2011	505	96	18
Nov.2011	514	101	17
Dec. 2011	508	99	15
Total	2037	394	66

Total production of four month = 2037, Total rejection = 66, pieces % of rejection = 66/ 2037 = 0.0324 x 100 = 3.24%

Data collection (before improvement) – MOTOR PULLEY

Month	Production pieces	Rejection Pieces	Misrun defects
Sep.2011	1002	180	39
Oct. 2011	1005	181	38
Nov.2011	1011	182	43
Dec.2011	1000	180	41
Total	4017	723	161

Total production of four month = 4017, Total rejection of Misrun defects = 161, pieces % of rejection = 161/ 4017 = 0.04007 x 100 = 4.01%

Data collection (before improvement) – Mini Chaff Cutter Wheel

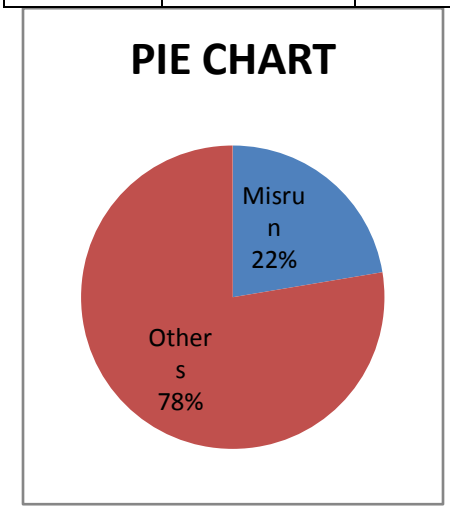
Month	Production pieces	Rejection Pieces	Misrun defects
Sep.2011	5004	828	233

Oct. 2011	5007	831	237
Nov.2011	5003	825	236
Dec.2011	5009	829	234
Total	20023	3313	940

Total production of four month = 20023, Total rejection of Misrun defects = 940 pieces % of rejection = 940/ 20023 = 0.0469 x 100 = 4.69%

Total rejection data for Misrun defect

Defects	No. of defective pieces	Percentage of rejection
Misrun	1167	1167/26077= 0.0447 x 100=4.47%



Pie chart for Misrun defect

IMPROVE PHASE IN MISRUN DEFECTS

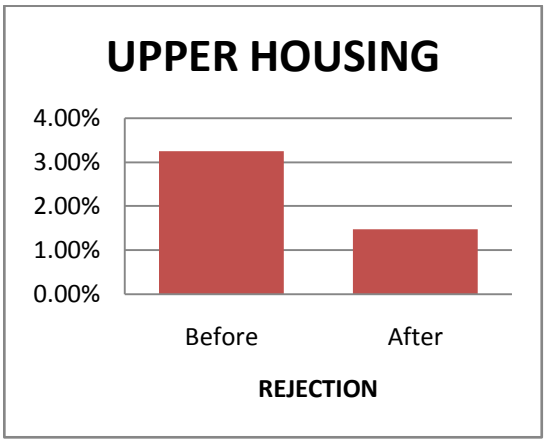
Improvement in Misrun defects: The root factors for Misrun defects were core shift and low pouring temp .Therefore to minimize this casting defect temperature has been increased and improve gate size has been controlled. So following action has been taken to improve this defect. Misrun defects have been minimized by raise pouring temperature 1145 degree to 1395 degree centigrade. Modify Gate size to reduce Misrun defects**.**

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

Data collection (after improvement) – Upper Housing

Total production of six month = 2026, Total rejection of Misrun defects =30 pieces % of rejection =30 / 2026 = 0.0148 x 100 = 1.48%

Data collection (after improvement) – Upper Housing



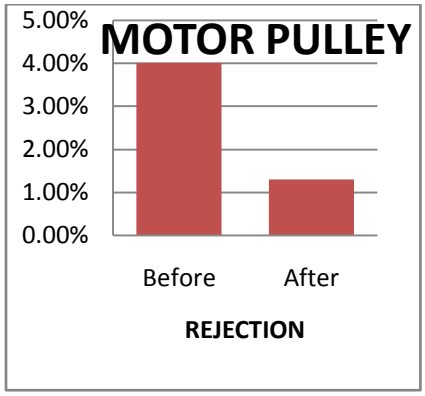
Bar chart for upper housing

Month	Production pieces	Rejection Pieces	Misrun defects
Feb.2012	503	30	06
March 2012	507	33	09
April 2012	504	31	07
May 2012	512	35	08
Feb.2012	1010	56	13
Total	2026	129	30
March 2012	1013	59	12
April 2012	1006	58	13
May 2012	1002	55	14

Total	4031	228	52

Data collection (after improvement) – Motor Pulley Total production of four month 4031, Total rejection =52 pieces % of rejection =52 / 4031 = 0.0129 x 100 = 1.29%

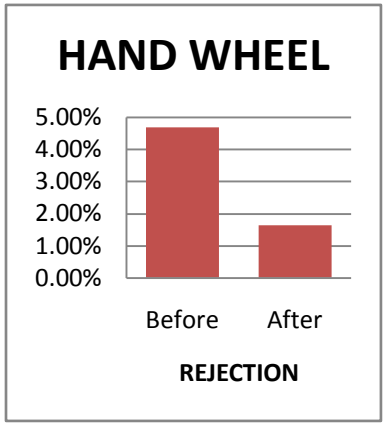
Bar chart for Motor pulley



Month	Production pieces	Rejection Pieces	Misrun defects
Feb.2012	5012	303	76
March 2012	5005	299	82
April 2012	5009	302	86
May 2012	5008	303	83

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

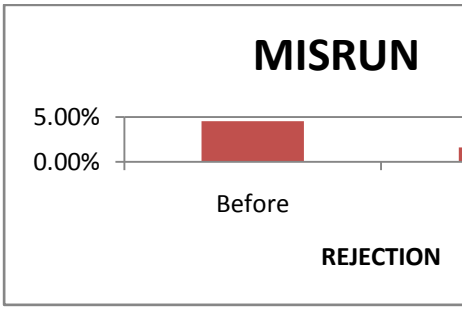
Total	20034	1207	327



Total production of four month = 20034, Total rejection =327, pieces % of rejection = 327/ 20034= 0.0163 x 100 =1.63%

Bar chart for Hand wheel/ Mini Chaff cutter wheel

Defects	No. of defective pieces	Percentage of rejection
Misrun	409	409/26091= 0.0157 x 100=1.57%



Bar chart for Misrun defects

Total rejection data (After improvement)

Improvements in rejection

Defects	Before improvement	After improvement
Misrun	4.47%	1.57%

So after the complete analysis it was found that rejection in Misrun defect has been reduced.

CONTROL PHASE FOR MISRUN DEFECTS

After the study of Misrun defects in ABC industries the following recommendations are made to control the reduction of Misrun defects of submersible pumps parts.To control the Misrun raise pouring the temperature. Modify gate size for control Misrun defect.

Overall analysis of Misrun after applying DMAIC process

Month	Type of defects	Number of defect	Percentage of defect	Factor	Result	Suggestions
Feb-May(2012)	Misrun	409	1.57 %	1.Temperature 1395 degree centigrade 2.Gate size	Low satisfaction	1.Raise pouring temperature 2.Modify size of gating system

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

COST BENEFIT ANALYSIS

The cost analysis of the savings in quarterly have been reflected in the following table

Cost analysis

S.No.	Product	Cost (Cast iron)@ 48/kg Wt cost	Previous rejection cost in Rs	After implementation of modification (rejection cost)
1	Upper housing	2.9 kg 139	394 x 139 = 54766	129 x 139=17931
2	Motor pulley	1.7 kg 82	723 x 82 = 59286	228 x 82= 18696
3	Mini Chaff cutter wheel / Hand wheel	1.5Kg 72	3313 x 72= 238536	1270 x 72= 91440
4		Total cost	352588	128067

Total four months saving = 352588-128067 = 224521/4= 56130 Rs. App.

Cost of additional material added in to sample of 100 kg

S.No.	Material	Quantity	Rate/kg	Cost
1	Silica sand	6.5 kg	Rs 4	Rs 26

			Total cost	26 /- PER 100 KG

Cost Benefits

S.No.	Product	cost of additional material
1	Upper housing	2.9 x 129 x 26/ 100 = Rs 97.26
2	Motor pully	1.7 x 228 x 26 / 100 =Rs 100.78
3	Mini Chaff cutter wheel / Hand wheel	1.5 x 1270 x 26/ 100 = Rs 495.30
4	Total four months cost	693.34 x 4= Rs 2773

Four months saving taking in to consideration of additional material = 56130 - 2773 =

Rs 53357/-

Monthly saving = 53357/4 = Rs 13339/-

RESULTS AND DISCUSSION

From the result of the application of DMAIC approach in the foundry shop the following results 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. The rejection due to slag defects were reduced from 5.77 % to 2.41% by using slag traps in gating system. The rejections due to

Misrun defects were reduced from 4.47 % to 1.57% by increasing temperature & improve the size of gates. The overall result of present work is clearly shows that by applying DMAIC approach the rejection has reduced from 16.96% to 5.99 % and saving of cost Rs 53357 (four months) and monthly saving of cost Rs 13339/-.

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.

REFERENCES

1. Anthony, R. and Banualas, W., "*Design for Six Sigma*", Journal of Research Technology and Management, Vol. 65, No. 1, 2002, pp. 23-25.
2. Bendell, R. and Corke, F., "*Successful Implementation of DMAIC Benchmarking General Electric Company Benchmarking*", An International Journal, Vol. 7, No. 40, 1999, pp. 260-281.
3. Bendall, F.and Marra, T., "*Six Sigma Black Belts: What Do They Need to Know*", Journal of Quality Technology, Vol. 33, No. 4, 2005, pp. 391-406.
4. Breyfogle, F., "*Featured Company Bechtel*", ASQ Six Sigma Discussion Magazine, Vol. 3, No. 1, 2004, pp. 4-6.
5. Catherwood, P., "*What Different about Six Sigma*", Journal of Manufacturing Technology, Vol.8, No. 3, 2003, pp. 2-5
6. Deutsch and Matra, B., "*A Discussion of strategies for DMAIC Implementation*", Quality Engineering Magazine, Vol. 12, No. 3, 2004, pp. 303-305.
7. Edward, D. and John, K., "*Integration of Lean and Six Sigma*", TQM Magazine, Vol. 5, No.1, 2005, pp 5-8.

8. Forrest, W., "*The Rise, Fall and Revival of Six Sigma*", Journal of Industrial Engineering and Management, Vol. 3, No. 1, 2007, pp 44-46.

9.Hackman, F. and Wageman, G., "*Why Should Statisticians Pay Attention to Six Sigma*", Journal of Productivity, Vol. 14, No. 2, 2003, pp. 100-103.

10. Shamsundar, B. K and Gadagkar, V., "Ceramic Filters – A practical View", Proceeding of Foseco India Ltd. (2004), pp-161-163

11. Sigworth, J., "*The Origin of the Equated Zone*", International Journal of Cast Alloys, Vol.5, No.1, 2000, pp 13-22.

12. Taylor, W., "*Theory of the Solidification of Castings*", Journal of Premium Strength Cast Iron Alloys, Vol. 23, No. 2, 1999, pp. 398-399.

13. Tony, B., "*Six Sigma and the Future of Quality Profession*", Quality progress Magazine, Vol. 3, No.32, 2004, pp 46-52.

14. Zbaracki, M., "*The Rhetoric and Reality of Total Quality Management*", Journal of Management System, Vol. 43 No.2, pp. 60-62.