Design of Gating System for Main Gear Box Housing

V U Sankpal[1], S S Shinge[2], B A Pawara[3], S P Ghanawat[4], S R Parit[5]& S M Ingale[6]
[1.2,3,4,5] *Student , Sanjay Ghodawat Group of Institutions, Atigre, Kolhapur, Maharashtra*
[6]*Associate Professor, Sanjay Ghodawat University, Kolhapur, Maharashtra*

Abstract- **Metal casting is the process of obtaining the product by pouring molten metal into the mold. The number of process parameters must be strictly monitored and controlled to produce the casting on demand. After the analysis she found that the design of the gating system, the feeding system, the orientation of the casting in the mould and the position of the dividing line play an important role in the production of high quality castings. In this paper we have presented the particularities of good mould and gating system design. We also tried to standardize the design of the casting system according to the type of casting. It is noted that the art of designing the gating system in conjunction with scientific procedures minimizes the number of studies, reduces the rejection and improves the yield**

Index Terms- **Design, Feeding System, Quality Casting, Yield**

I.INTRODUCTION

Our research paper is related to design of the gating system for Main Gear Box Housing. like pouring basin, sprue, sprue well, runner, in gate and vent. As per the observation in the foundry the above product has the defect due to which rejection take place about 12 to 15% of the total casting. From the data collected for rejection over past months it was found that Main Gear Box Housing have maximum rejection as compare to the any other product of foundry. Use of simulation software is recommended to reduce trials during for validation, reduce lead time and controlling the rejection. Though the rejected casting can only be remelted, the value addition made during various processes such as molding, melting and fettling etc. are lost irrecoverably

II. LITERATURE REVIEW

Dr. B. Ravi et.al.[1]in his paper have developed model for design of product tool, method and process plan. It is helpful to improve quality of casting. Both technological resources and technological skills are essential for global manufacturing competence.

Dr. ThoguluvaRaghavanVijayaram et.al.[2] discussed briefly about the extensive use of computers in the mechanization of foundries. The mechanization and modernization of the foundry is of great importance today when Foundry has developed from an old art to a modern science and is controlled and monitored entirely by computers. Modernization is the only key to improving casting quality and productivity.

Joshi and Jugular [3] introduced systemic approaches to find cause of errors that occurred through manual operations. From the analysis it was found that manual metal casting processes are carried out with some negligence and negligence. So, proposed by some other remedies and by their implementation it reduces total rejection more than 30%.

Narayanswamy and Natrajan [4] investigated various casting errors. Categorize defects in filling-related defects (FRD), the form-related defects (SRD), and Thermal defects (TD) and defects to appearance. From these defects, the fill-related defects are important for the analysis and it is mainly due to the quality of the sand.

Dr. B. Ravi [5] presented the importance of the simulation compared to workshop tests, the process of simulation, i.e. input, result and application. Presented to the foundry owner-how to buy, use together with the use and application of a simulation software taking into account all possible considerations.

Kamlesh Singh and ABS. K. Reddy [6] presented - how Cross can be reasons for the defective cause in casting. Presents an overview of the possible type of intersections also what kind of hybrid are minimal defects on the large. Here, the author introduced the use of simulations to determine possible defects. Here process is the intersection have been modeled solid and subjected to a solidification simulation to predict the location of defects. Geometric variations in node design have also been analyzed to investigate the impact on error location and extent.

Sutaria, M. D. Joshi, M. Jagdishwar and B. Ravi [7] presented the automatic optimization of casting feeders by means of venting supply paths and explained the effects of the supply or slope system of a casting on the internal quality as well as the yield of a casting. They focus mainly on the feeding system, feed paths, solidification simulation, shrinkage errors. The direction of the microscopic metal flow is called Feed path. In this paper, specify the classification of the feeding system.

Dr. V. A. Raikar, S. M. Ingale and T. B. Shinde [8] have analyzed and checked transmission cover defects using quality control tools. The use of simulation software is recommended to reduce attempts during validation. Percentage rejection of major transmission coverage defects, but also total rejection decreased from 28.4% to 18.7 %.

III. METHODOLOGY

The first step in the defect analysis is to identify the casting defect correctly. Then the identification of the sources of the defect is to be made. The involvement of the various variables in the process makes difficult to identify the exact source of the defect. Systematic analysis is required to control or reduce the defects by taking the necessary corrective remedial actions. Implementation of wrong remedial actions makes the problem complicated and severe. In this paper the vital few causes of rejection of casting was analyzed using defect diagnostic approach as shown in the fig. 1 below.

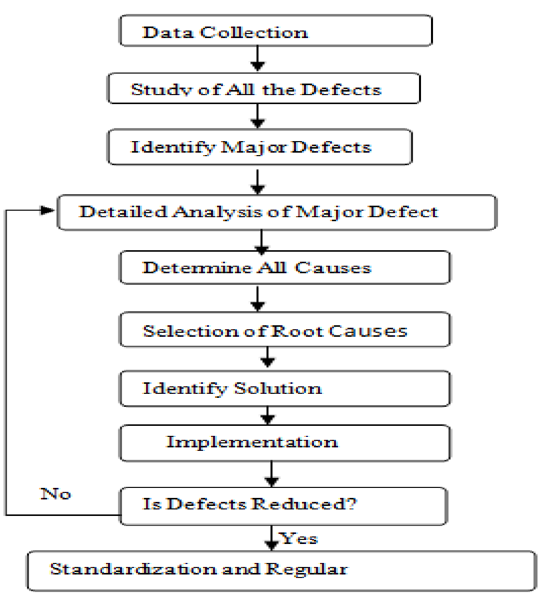

Figure No.1Methodology

IV. DESIGN ELEMENTS OF GATING SYSTEM

As in this case blow hole is the major defects which is mainly take place in the gating system. So, it is necessary to design the gating system.

The parameter which we undertake for calculation are

1. Pouring Time
2. Choke Area
3. Design of Sprue
4. Design of Ingate
5. Design of Riser

First will calculated pouring time

1. Pouring Time: -

As we know pouring time depends on the casting materials, complexity of the casting, section thickness and casting size. As we know our product size is less than 450 kg and average thickness is less than 15 mm so we have to use a standard formula used for thin walled casting of thickness 2.5 to 15mm and weight less than 450 kg.

$t = S\sqrt{W}$ in sec

Here,

S = 2.2 for table in which average thickness is between 8 to 15 mm

Table No.1 Selection of the Coefficient-S

Thickness of casting, mm	2.5-3.5	3.5-8.0	8.0-15.0
S	1.63	1.85	2.20

W is given by equation which is W = Mass of the casting product dividing by casting in yield in present unit is kg.

$$t = 2.2\left(\sqrt{\frac{26.07}{70} * 100}\right)$$

$t = 13.42 \approx 14$ second

2. Choke Area (Ac):-

The choke area is determined by using following formula

$$A = \frac{W}{dtc\sqrt{2gH}}$$

Here,

W = 37.24 kg.

H = 152 mm Reference taken form sanmati industries

C = 0.9 Reference taken form manufacturing technology second edition author P. N. Rao page no. 141

$$Ac = \frac{37.24}{0.89*10^{-6}*7.25*14*\sqrt{2*9810*152}}$$

Ac = 236.06 mm^2

Design of Sprue

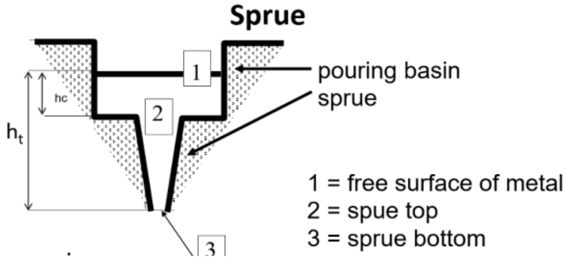

Figure No. 2 Sprue cross section

Sprue height = 152mm

Sprue well

Area of sprue well

= 2*area of sprue choke

= 2*236.06

= 472mm^2

3. Design of Runner

Assuming ratio as

Ac:Ar:Ag = 4:3:2

$\therefore$ Ar = 3Ac

= 3*236

= 708 mm^2

Height and width of runner

Height of runner = width of runner = a

There for $a^2 = (708)$

a = 26.60 ≈ 28 mm

a = 28 mm

Design of Ingate

Here,

Ag = 2Ac

= 2*236

= 472 mm^2

No. of gates = 4

Ag = 472 mm^2

Height of ingate = a = 15.36~16 mm

Width of ingate = 2a = 32 mm

There for

a = $\sqrt{472/2}$ = 15.36 mm ~ 16 mm.

4.Design of Riser

By referring cain's method,

We know volume of casting = 3382444.57

Area of casting = 621700.23 mm^2

Volume of riser = $\frac{\pi D^2}{4}$

Surface area of riser = $\pi D^2 + \frac{\pi D^2}{4}$

= $1.25\pi D^2$

$$X = \frac{SA_{casting}\ /V_{casting}}{SA_{riser}\ /V_{riser}}$$

Therefore,

$$X = \frac{621700.23/3328444.57}{1.25\pi D^2/1.25\pi D^3}$$

$$= \frac{0.1868D}{5}$$

X = 0.0373D

$$Y = \frac{Volume of ruser}{volume of casting}$$

$$= \frac{0.25\pi D}{3328444.57}$$

$= 7.511*10^{-8}*D^3$

Based on the Chvorinov's rule. Caine developed a relationship empirically for the freezing ration of follows.

$$X = \frac{a}{Y-b} - c$$

For Grey cast iron a = 0.33 b = 0.030 c = 1.00 --- Reference taken form manufacturing technology second edition author P. N. Rao page no. 158

$$X = \frac{a}{Y-b} - c$$

$$0.0373D = \frac{0.33}{7.511*10^{-8}*D^3 - 0.03} - 1$$

$$0.0373D = \frac{0.33-(7.511*10^{-8}*D^3)+0.03}{7.511*10^{-8}*D^3 - 0.03}$$

$2.79*10^{-8}*D^4 - 0.01D = 0.33 - 7.5*10^{-8}*D^3 + 0.03$

Take diameter D = 87.5

And H = h = 131.25 ≈ 132mm.

V. IMPLEMENTATION OF GATING SYSTEM

Gating system designed is implemented which is shown in figure below.

Figure No. 3 Casting with gating system.

VI. CONCLUSION

Pareto chart and fish bone diagram is useful in identifying the root cause. Proper design of gating system helps to produce quality casting. It helps to reduce rejection and increase in

REFERENCES

[1] Dr. B. Ravi etal (2011), "A Holistic Approach to Zero Defects Casting" Technical Paper for 59TH Indian Foundry Congress.

[2] Dr. Thoguluva Raghavan Vijayaram, Dr Paolo Piccardo,(2012) "Computers in Foundries", Metallurgival Science and Technology, Vol. 30, Issue. 2, 2012, pp.28-38.

[3] Joshi Aniruddha, Jugulkar L.M, "Investigation and analysis of metal casting defects and defect reduction by using quality control tools", International Journal of Mechanical and Production Engineering ,2,2014,87-92,ISSN:2320-2092.

[4] C. Narayana swamy, K. Natarajan, "Optimization of casting defects analysis with supply chain in cast iron foundry process", METALURGIJA 55, 4, 2016, 815-817, ISSN 0543-5846.

[5] B.Ravi, "Computer-Aided Casting – Past,present and future," Indian Foundry Journal, 45(1), 65 to 74, 1999.

[6] Kamalesh Single, "3D junction in Castings: Simulation-based DFM Analysis and Guidelines".

[7] M.Sutaria, "Automatic Optimization Of Casting Feeders Using Feed-Paths Generated By VEM"

[8] V.V.Mane Amit Sata and M.Y.Khire et al. (2007) "New Approach to Casting Defects Classification and Analysis Suported by Simulation", Techanical Paper.

[9] Dr. V. A. Raikar, S. M. Ingale and T. B. Shinde, "Paradigm Shift in Casting Defect Analysis and Control using Quality Control Tools and Simulation for Production of CI Casting", International Conference on Sustainable Growth through Universal Practices in Science, Technology and Management (ICSGUPSTM-2018), Goa, June 8-10, 2018, page no 67 -71

[10] Aju Pius Thpttungal, Sijo. M. T(2008) er al."Controlling measures to reduce Rejection rate due to forging Defects" International Journal of Scientific and Research Publications, Volume 3, Issue 3, March 2013 1 ISSN 2250-3153.

[11] B. Chokkalingam & S.S. Mohamaed Nazirudeen, "Analysis od Casting Desfect Trough Defect Diagnostic Study Approach", Journal of Engineering Annals of Faculty of Engineering Hunedoara, Vol. 2, pg no.209-212, 2009.

[12] H.C.Pandit and S.M.Ingale, "Casting Optimization Aided By Simulation", International Conference on Sunrise Technologies, 13th-15th Jan 2011,pp.4-7.

[13] Andreas Felsberger, BernhardOberegger, GeraldReiner , "A Review of Decision Support Systems for Manufacturing Systems", SamI40 workshop at i-KNOW "16,Graz, Austria,2016,pp.1-8.