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REJECTION ANALYSIS AND PROBLEM SOLVING FOR BRASS CASTINGS OF SHOWER RAIL NUT AND SINK MIXER FAUCET

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ABSTRACT

The present work emphasizes on the removal of defects of a brass casting industry by doing analysis of rejections due to defects and then solving problems. The study was focused on the defect removal of cast shower rail nut and sink mixer to reduce their rejection. Quality tools such fish bone diagrams and graphs were used for approaching the appropriate solutions. Rejections in different casting products were critically analyzed for one month and then reduced continuously by implementing solutions after analyzing the various causes. Data for two consecutive months was further observed and successfully the rejection was reduced for both the cast items to improve productivity.

KEYWORDS: Rejection, Fish bone, Casting, Brass, Faucet, SEM.

1. INTRODUCTION

Industrial problems generally perform as path holes in technology that lead to poorer quality, rejections, fall in production, and losses. Rejection rates are a major issue in the foundry industry [1]. A defect may be due to a single cause or a combination of causes [2]. Sand casting is the most used process in foundries [3]. Casting is also a very versatile process and is capable of being used in mass production [4]. Casting defect analysis is the process of finding the root causes of occurrence of defects [5]. Foundry industries need to produce castings with minimum of defects [6] due to its uncertainty [7].

Problems in casting process act as demotivator [8]. Thus, to remove such problems is always a priority through project formulations, quality circle concepts etc. Problem solving does not only act for defect removal but a part of manufacturing process-based technique that incorporate appropriate methodologies at all levels of organization [9]. Thus, the problem-solving approach is a transition from the traditional fault management approach of finding, fixing, or rejecting as commonly applied, graduating now to inculcating an incentive to eliminate defects [10].

It not only eliminates faulty goods, but also reduces the expense of quality testing, reprocessing, and scrapping. A change in focus from the inspection of finished goods to continuous monitoring of the manufacturing of parts is needed to reduce the number of defects [11]. In this case through casting defects, during casting process, the unit faced number of problems related to poor quality i.e. casting operation not qualifying the required specifications, rejections, and premature failures at the foundry shop itself. And some failed in the machining shop during machining i.e. defects came out of the castings and they were rejected. There were number of reasons responsible for these problems and resulting in rise in rejection and rework etc. These problems lead to reduction of process capability. Detailed schedule to study each type of each problem was charted, problems analyzed and solved [12]. Evidently, solution of problems is must to be competitive. Problem solving exercise enabled identification of the reasons and helped providing appropriate remedy.

In the present study an attempt was made to reduce the rejection of the cast shower rail nut and sink mixer. Defects were identified through the SEM and image analyzer and cause of the defects were found. By using fish bone diagram focus was made on the cause of defects and further solutions were implemented to reduce the rejection of cast products.

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2. METHODOLOGY OF ANALYSIS

The problems were analyzed using cause and effect diagrams, which is one of the most effective methods for identifying the causes pertaining to a problem. It constitutes the spine of a fishbone chart on which there is a quality characteristic that is to be improved or the quality problem being investigated. Secondary causes like casting design, moulding, gating & risering, sand and cores, melting and pouring become secondary bones connected to the spine, tertiary causes like directional solidification not taken care of, low green compressive strength and high pouring temperature were connected. Extremity bones were made as target of experiments in the end indicated in a circle. The moment a diagram is used to ensure a focus for problem solving, the goals and objectives are set.

Two major problems in brass die casting process were analyzed and appropriate solutions were given to avoid future rejections. So, two case studies were considered in this article, in which following problems were identified and were reduced using fish bone diagram: -

- Gas porosity was a big problem in die casting process of Shower rail nut.
- Distorted cores in casting of sink mixer.

3. CASE STUDY 1

The gas porosity (blowholes/pinholes) was revealed by studying the scanning electron micrograph of shower rail nut shown in Figure 1 and image analyzer view shown in Figure 2. To analyze the cause of the gas porosity, fish bone diagram was made by deep study of six processes involved in the casting of shower rail nut as shown in Figure 3. It is in the die closing step, closing of die was improper and there was moisture in the dies.

Figure 1. SEM of shower rail nut

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Figure 2. Image analyzer view of the shower rail nut

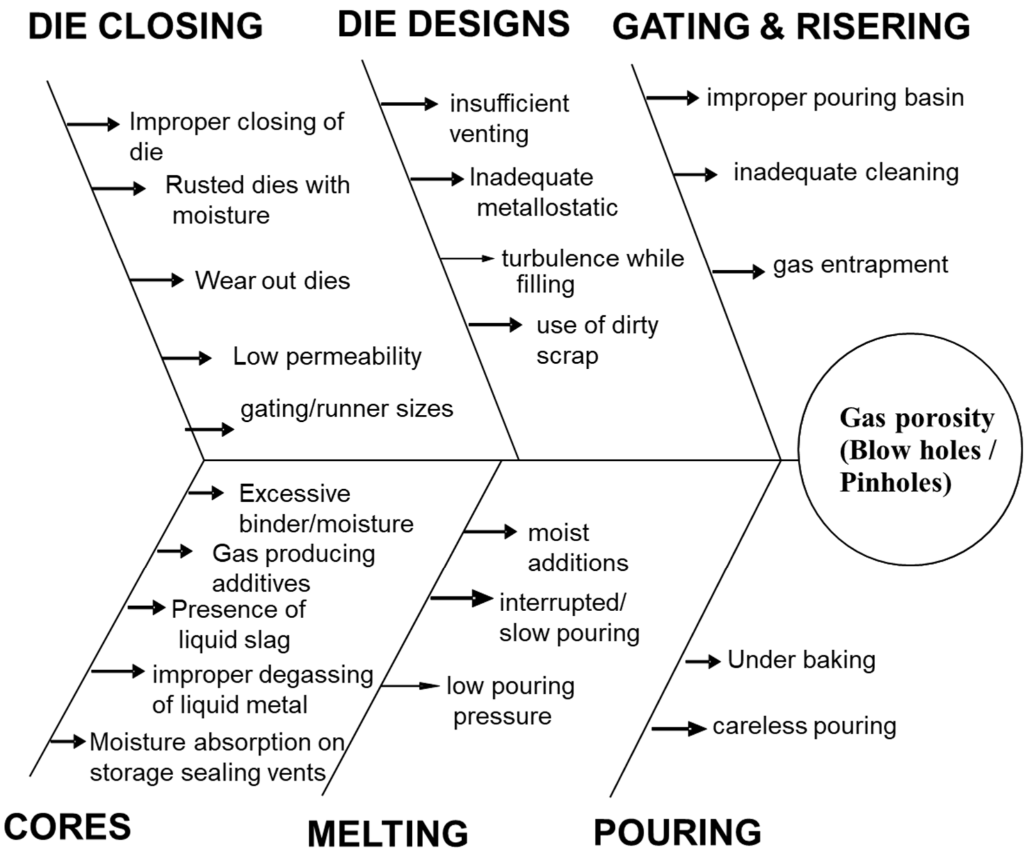

FIGURE 3. The fish bone diagram for gas porosity

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Due to die design there was insufficient venting, inadequate metallostatic turbulence during filling and dirty scrap was used. In gating and risering there was poor basin pouring and gas was entrapped. Cores were not up to the mark. There were two pieces cast per casting, so the cores were not placed properly. Also, excessive binder/ moisture was seen along with less moisture absorption on storage sealing vents. There was presence of liquid slag and improper degassing of liquid metal. Melting was appropriate however in pouring process there was low pressure leading to interrupted and slow pouring. Moreover, under baking and careless pouring was also observed. The common cause of gas porosity observed were turbulence and cores not properly dried.

Solution to reduce gas porosity

To reduce the porosity optimum speed was recommended to make sure that no turbulence would be there. Cores were dried for more time in the oven and then were used.

4. CASE STUDY 2

The second case study was done on improper core shape of sink mixer. Cores of sink mixers were not of exact shape as that of die and due to that the castings were not having proper internal shape such as hot and cold water outlets and mixed water outlet were not providing the required type of water for which the product was designed.

Analysis of the Problem:

The cores were made by core men and was completely dependent on the skill of the workers. Sometimes the cores were better and sometimes the cores were not good. As surveyed during the course it was found that automation could increase the capacity of the core making process by three times. Core making was carried every day and the cores for present day and the next day were made and then cores were kept in a cupboard for further use. Cores were surveyed and it was found that the core sand with which the cores were being made was having very small clots of molasses and sand which were not properly mixed up. Sometimes core sand used was previous day's mixed sand. Cores which remain lied for one or more day got moist. The brass casting of sink mixer was cut and seen that the defect of improper mixing of water was due to improper cores when matched with the drawing of the casting. The main reasons for the improper shape of the core of sink mixer were

- Inadequate cleaning of the core boxes after each core was made, lied there sticked to the sharp corners.
- Core box of sink mixer was found to be of not proper shape and core box needed repair.

Solutions for the shape problem of core

To reduce the rejection of the sink mixer on the base of shape of core, the core boxes for sink mixer were repaired and proper cleaning of the sharp corners of the core boxes was done. Core makers were trained to apply powders properly to the core boxes.

5. RESULT AND DISCUSSION

Data for production, rejection and rework of foundry was procured. The data collected was to analyze the production of the foundry and this data was collected for various brass castings against their commercial names. Casting wise data for production was collected and rejection and rework against each casting was collected and finally the rejection and rework in totality was collected. Summary of the collected data is shown in Table 1.

Table 1. Data Collected for casting defects for three months

Month	Production (kg)	Casting	Rejection (kg)	Rework (kg)
1st Month	5981.22	94	200.494	67.693
2nd Month	6330.27	91	128.606	97.99
3rd Month	5459.636	90	63.104	187.434

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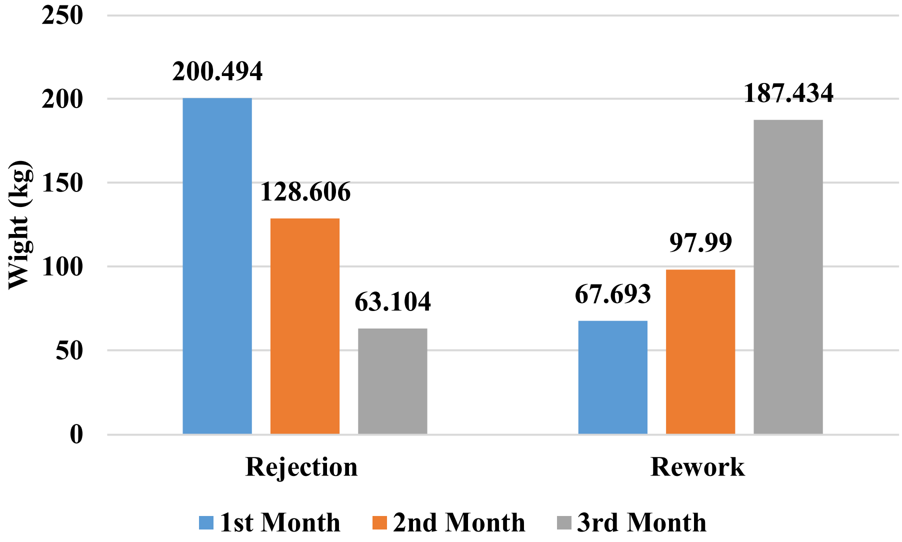

Figure 4. Rejection and Rework for the three months

The data was collected for three months. In the first month the observations were made as discussed in case study 1 and 2. Further the continues suggestions were implemented step by step and data was collected, and improvement was observed. In the first month data was collected for about 94 castings and the foundry production was 5981.22 kg and the respective casting rejection and rework was 200.494 kg and 67.693 kg as shown in Figure 4. It means that 200.494 kg weight brass was melted and cast again and certainly there was a wastage of time, manpower and money and most important of manpower. After implementation of the partial suggestions related to both the defects the data was collected in second month for the same number of castings and the production was calculated for about 91 castings and it was 6330.277 kg. The rejection was 128.606 kg and the rework was 97.99 kg as shown in Figure 4. In this month there was an improvement in rejection, which was reduced from about 200 to 128 this month, and the rework was increased, which was needed to be considered. In the third month all the suggestions were implemented, and the data was collected for about 90 castings. Production of castings for this month was 5459.636 kg. The rejection and the rework were respectively 63.104 kg and 187.434 kg as shown in Figure 4. Here in this month the rejections were reduced from 128 to 63 due to the improvement work done and the rework was increased from 97 kg to 187 kg. Figure 5 shows the percentage reduction of rejection and percentage increase in rework. There was 60.6% and 57% reduction in the rejection in second and third month and 137% and 221% increase in rework in second and third month. Increase in rework was not too bad as compared to the rejection because in case of rejection the work piece is completely rejected but with the rework it's possible to reuse it with certain modifications which are more economical as compared to rejections.

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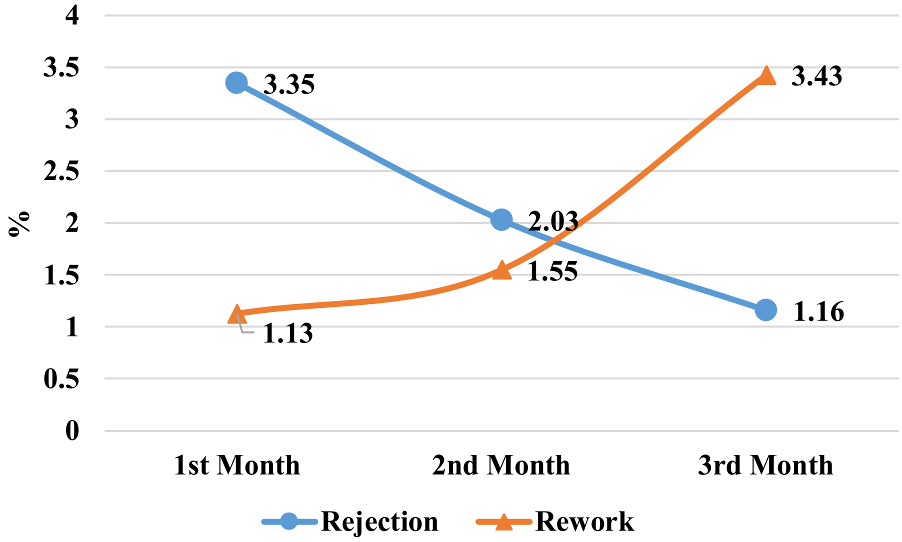

Figure 5. Percentage of rejection and rework in each month

6. CONCLUSIONS

An improvement was made in the casting of shower rail nut and sink mixer by reducing the blowhole and core shape defects. In the production of shower rail nut, the five steps involved in casting were deeply analyzed. SEM along with image analyzer were taken for the defected shower rail to identify the type of defect. For each step, the reasons for blowholes/pinholes were identified and analyzed through fish bone diagram. Similarly, reasons for the improper shape of cores were identified. Based on analysis some solutions were implemented. To study the defects and rejection, data was studied for the consecutive three months. The improvement in the casting was observed in the later months. There was reduction in rejection from 60.5% to 57% of the cast products. However, increase in rework was observed from 137% to 221%. Overall improvement in quality and the production was enhanced with raised morale of the workers.

REFERENCES

[1] Binu Bose V and K N Anil kumar, Reducing rejection rate of castings using Simulation Model, International Journal of Innovative Research in Science, Engineering and Technology; Volume 2, Special Issue 1,2013; ISSN: (Print) : 2347 – 6710. Pg 589-597.
[2] Siddalingswami. S. Hiremath and . S. R. Dulange, international journal of innovations in engineering research and technology [ijiert] issn: 2394-3696 volume 2, issue 9, sep.-2015, pg 1-9
[3] 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 DOI : 10.18231/2454-9150.2018.0212 pg 67-71
[4] Hardik Sheth , Kushal Shah , Divyesh Sathwara , Rushik Trivedi; Investigation, Analysis of Casting Defect By Using Statistical Quality Control Tools, 2015 IJEDR Volume 3, Issue 4 ISSN: 2321-9939 pg 247-254
[5] Patil Sachin S, NaikGirish R., Process Improvement in Casting through Defect Minimization: A Case Study. International Journal of Scientific & Engineering Research, Volume 8, Issue 4, April-2017 ISSN 2229-5518 page 274-279
[6] Narayanaswamy and Natarajan. K; Review Analysis of Casting Defects with Respect to Indian Standards in Cast Iron Foundry, Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115, JCHPS Special Issue 2: August 2016, pages 63-68.
[7] Sidhant Arvind Karnik, Bhushan Shankar Kamble, Diagnostic approach towards analyzing casting defects-An Industrial case Study, International Journal of Advanced Research in Science, Engineering and Technology Vol. 5, Issue 4, April 2018 ISSN: 2350-0328 pg 5616-5625.

[8] Surjit Kumar Gandhi, Anish Sachdeva and Ajay Gupta, Reduction of rejection of cylinder blocks in a casting unit: A six sigma DMAIC perspective; Journal of Project Management 4 (2019) 81–96 doi: 10.5267/j.jpm.2019.1.002

[9] I Ohnaka, How to solve complex problems in foundry plants - future of casting simulation, IOP Conf. Series: Materials Science and Engineering 84 (2015) 012034

[10] Javedhusen Malek, Darshak Desai, reducing rejection/rework in pressure die casting process by application of DMAIC methodology of six sigma, International Journal for Quality Research 9(4) 577–604 (2015) ISSN 1800-6450

[11] Sunil kumar and Gayatri Brahma, Prabhkiran Kaur, Brijesh kumar Gupta, A case study on quality improvement of connecting rod assembly line using Six sigma DMAIC cycle, International Journal of Six Sigma and competitive advantage, Vol. 12 Nos 2/3 2020.

[12] Prabhkiran Kaur, Sunil Kumar, "Time Study Based Worker Activity Improvement Program", Proceedings of the Conference on National Conference on Design, Dynamics and Manufacturing (NCDDM-07), 16-17 March, 2007, Department of Mechanical Engineering, Sant Longowal Institute of Engineering and Technology, Longowal, Sangrur, Punjab, India.