IJARESM
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

REDUCING CASTING DEFECTS AND IMPROVING PRODUCTIVITY IN A SMALL SCALE FOUNDRY: A REVIEW

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***ABSTRACT**: Casting has various processes like Pre casting Processes, pattern making, core making, molding and mold assembly making, Casting Processes, furnace charging, melting, holding and pouring, and Post casting Processes, shakeout, inspection and dispatch etc. In India there are many foundry have followed conventional and manual operations. Mold shifting, Crushing, Lower Surface finish, Shrinkage, Porosity, Cold shut and Extra material are common casting defects due to these manual operations. Improve quality and productivity by apply seven quality control tools technique sum of the known problems which are face in the small scale to top level scale of industries. This review paper presents all data of manual sand casting operations and defects leads to rejection and also represents analysis of these defects with seven quality control tool.*

Key Word: **Seven quality control tools, Productivity, Casting defects, Cold shut**

INTRODUCTION

Sand casting is one of the direct methods of manufacturing the desired geometry of the part. Casting or the process of foundry is very efficient and effective manufacturing process, which can transforms raw material into different output. The principle of manufacturing of casting involves creating a cavity inside a sand mould and then pouring molten metal directly into mould cavity. Casting is very multipurpose process being used for number of engineering applications in today's world.

In India, manual casting production method is most common in number of foundries. The activities involved in casting process are, Pattern making for creation of mold box, Core making for insertion in mold assembly, fitting of pattern, gating system and sand for mold preparation, remove prepared mold and placed for pouring, fill the mold cavity with molten metal, allow it to solidify and at last, remove the cooled desired casting. These activities are commonly used because of its simplicity in process, economic to operate and easy to produce small size castings. In this work manual metal casting operations of an automotive component producing foundry are studied where components of different size and shape are produced. In this study defects of casting processes are known which directly affecting rejection level of organization and reduces productivity and quality level of industry.

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The 7 QC Tools are simple statistical tools used for problem solving. These tools were either developed in Japan or introduced to Japan by the Quality Gurus such as Deming and Juran. In terms of importance, these are the most useful. Kaoru Ishikawa has stated that these 7 tools can be used to solve 95 percent of all problems. These tools have been the foundation of Japan's astomishing industrial resurgence after the Second World War.

For solving quality and productivity problems seven QC tools used are Pareto Diagram, Cause & Effect Diagram, Histogram, Control Charts, Scatter Diagrams, Graphs and Check Sheets. All this tools are important tools used widely at manufacturing field to monitor the overall operation and continuous process improvement. This tools are used to find out root causes and eliminates them, thus the manufacturing process can be improved. The modes of defects on production line are investigated through direct observation on the production line and statistical tools.

LITERATURE REVIEW

B. R. Jadhav, Santosh Jadhav (2013): In this paper a casting defect named cold shut is diagnosed for its causes. Seven quality control tools are used to find the root cause of the problem. Cold shut is a visual and structural discontinuity. The quality control tools used consists of Pareto diagram, Control charts, Scatter diagram, Histogram, Ishikawa diagram and Brainstorming etc.

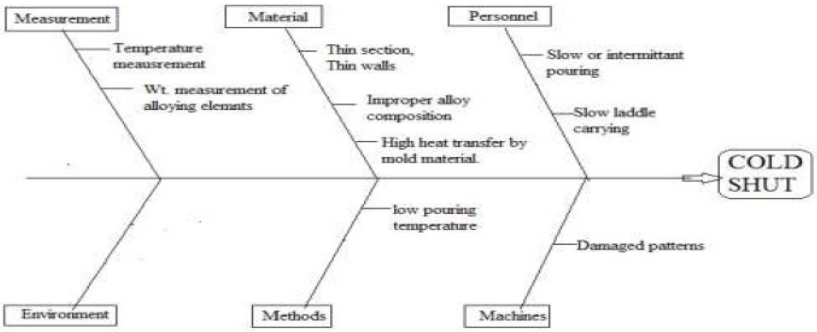

Figure 1: Root cause analysis for cold shut defect

Automotive cylinder block is taken under study. Rejection data of 3 months is collected and analysed. This data is represented by using various quality controls tools such as Histogram, Control charts and Ishikawa diagram. From this data we can diagnose the casting for defects and their causes in an early stage. A systematic approach for rejection control using seven quality control tools is discussed in this paper. Here in this case alloy composition and pouring temperatures were the root causes of the problem. Total rejection is reduced to 6.6% from 12.3%.

Pranay S. Parmar, Vivek A. Deshpande (2014): After reviewing some research papers different results are taken and give main objective using 7 QC tools is (to reduce rejections) most useful and economical tools. These tools and techniques are simple to implement and it needs the top management involvement and employee support. Although SPC seems to be a collection of statistically based problem-solving tools, there is more to the successful use of SPC than learning and using these tools. SPC is most effective when it is integrated into an overall, companywide quality improvement program.

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Varsha M. Magar, Dr. Vilas b. Shinde (2014): In this paper general idea about all 7 QC tools and its importance regarding to minimize the risk of errors in systems. It enhances workers ability to think generate ideas, solve problem and do proper planning. The main aim of this paper is to provide an easy introduction of 7 QC tools and to improve the quality level of manufacturing processes by applying it. QC tools are the means for Collecting data, analyzing data , identifying root causes and measuring the results. These tools are related to numerical data processing .All of these tools together can provide great process tracking and analysis that can be very helpful for quality improvements. These tools make quality improvements easier to see, implement and track.

Uday A. Dabade and Rahul C. Bhedasgaonkar (2013): In this paper have put their emphasis on casting defect analysis using Design of Experiments and Computer Aided Casting Simulation Techniques. They work to analyze the sand related and methoding related defects in green sand casting. They applied Taguchi based orthogonal array for experimental purpose and analysis was carried out using Minitab Software for analysis of variance and analysis of mean plot. Also they worked for shrinkage porosity analysis using casting simulation technique by introduction of new gating system design. So the results obtained to them with new gating and feeding system design are reduction in shrinkage porosity about 15% and improvement in yield about 5%. From the literature review it is revealed that successful application of Pareto analysis and CED can significantly reduce the defects of manual casting operations and increases efficiency. In this paper sand preparation, mold making, pouring and shakeout processes are considered for reducing defects rate.

T.R. Vijayaram, S. Sulaiman, A.M.S. Hamouda, M.H.M. Ahmad(2005): In this review paper, some of the solutions and quality control aspects are explained in a simplified manner to eliminate the unawareness of the foundry industrial personnel who work in the casting manufacturing quality control departments. This review paper provides very valuable information to the young manufacturing and mechanical engineers who have interest to start their career in the manufacturing concerns of medium and large scale captive foundries. This paper discusses all about the general quality control aspects in a detailed manner. Besides, statistical quality control (SQC) is also highlighted to understand its recent application and techniques adopted in the developing metallurgical engineering foundries.

Chiragkumar S. Chauhan, sanjay C. Shah, Shrikant P. Bhatagalikar(2013): In this review paper has been conducted in order to define role and importance of seven basic quality tools (7QC tools) within quality management system. To stay in continuous improvement continuous staff education and training is necessary. Quality tools has important place in data collecting, analyzing, visualizing and making sound base for data founded decision making. The paper stresses on the use of the seven basic quality tools to improve processes and to solve problems.

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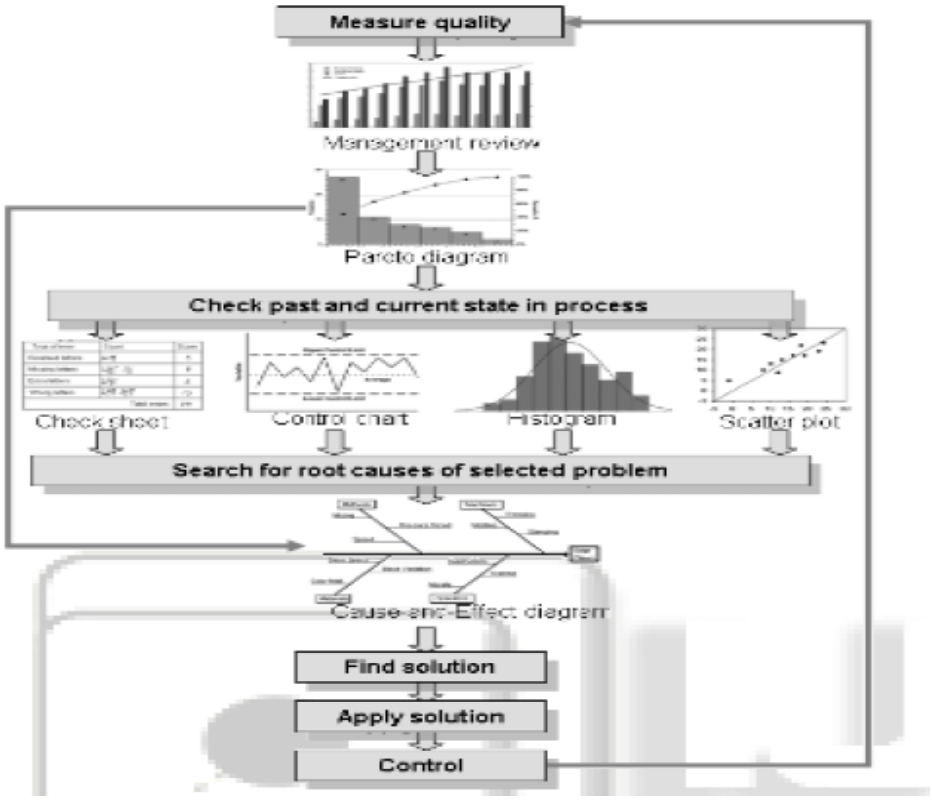

Figure 2: Approach of Application of Seven quality tools (7QC tools)

B. Naveen, Dr. T. Ramesh Babu: In this review paper has collected data it has been identified that the production time is less than the takt time for the case study organization hence in order to meet the demand it is important to implement the suitable industrial engineering tools. By implementing, it can reduce the cycle time and work-in-progress. Reduction of waste can be also improve productivity. Cause and effect diagram was used to identify the causes which reduces the production rate.

Basic 7 Quality control tools

1. Check Sheet
2. Histogram
3. Pareto Chart
4. Cause and Effect Diagram
5. Flow Chart
6. Control Chart
7. Scatter Diagram

1. Check Sheet: Check sheets are simply charts for gathering data. They are easy to understand and very clean to read.
2. Histogram: A histogram is a snapshot of the variation of a product or the results of a process. It often forms the bell-shaped curve which is characteristic of a normal process. The histogram helps to analyse what is going on in the process whether the data is falling inside the bell-shaped curve and within specifications.
3. Pareto Chart: The Pareto chart can be used to display categories of problems graphically so they can be properly prioritized. Pareto chart is a vertical bar graph displaying rank in descending order of importance for the categories of problems, defects or opportunities.
4. Cause and Effect Diagram: The Cause and Effect Diagram display the relationships between different causes for the effect that is being examined. The major categories of

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causes are put on major branches connecting to the main line, and various sub-causes are attached to the branches.

5. Flow Chart: Flow chart breaks the process down into many sub-processes. Analysing each of these separately minimizes the number of factors that contribute to the variation in the process.
6. Control Chart: As discussed above they are used to monitor the process.
7. Scatter Diagram: A Scatter plot is used to show how a pair of variables is related and the strength of that relationship. It is constructed by plotting two variables against one another on a pair of axes.

CONCLUSION

A review research article has been carried out in order to define role and importance of seven basic quality tools (7QC tools) within quality management system.

1. Seven Quality Control Tools are used for data collection, data analysis, to identify root cause of the defects (problem) and cause and effect analysis. In casting industry the defects can be reduced using these tools up to 5.7%.[1]
2. Seven quality control tools and techniques are simple to implement and it needs the top management involvement and employee support. [2]
3. Statistical QC is mainly concerned in making sure that several procedures and working arrangements are in place to provide for effective and efficient statistical processes, to minimize the risk of errors or weaknesses in procedures or systems or in source material. All processes are affected by multiple factors and therefore statistical QC tools can be applied to any process. [3]
4. A new method of casting defect analysis is suggested, which is a combination of design of experiments method (Taguchi method) and computer aided casting simulation technique for analysis of rejection of casting due to defects related to sand, moulding method, filling and solidification in green sand casting. With Taguchi optimization method the % rejection of castings due to sand related defects is reduced from 6.41%.[4]
5. It is suggested that careful supervision with effective motivation of individual employees in achieving the quality is a must in reducing the rejection and scrap in metal casting manufacturing engineering industries. [5]
6. Quality tools has important place in data collecting, analyzing, visualizing and making sound base for data founded decision making. The paper stresses on the use of the seven basic quality tools to improve processes and to solve problems. It should be changed through continuous staff education and training. [6]
7. The production time is less than the TAKT time for the case study organization hence in order to meet the demand it is important to implement the suitable industrial engineering tools. It can reduce the cycle time and work-in-progress. Reduction of waste can also improve productivity. [7]

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