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ANALYSIS OF CASTING DEFECT THROUGH DEFECT DIAGNOSTIC STUDY APPROACH

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Abstract
Production of casting involves various processes like pattern making, moulding, core making and melting etc. It is very difficult to produce defect free castings. A defect may be the result of a single cause or a combination of causes. The castings may have one or more defects. These can be minimized by taking correct remedial actions in the tools like pattern, core box and foundry processes like pattern making moulding, core making and melting. This paper presents a systematic procedure to identify as well as to analyze a major casting defect (mould crush) occur in an automobile transfer case casting poured in cast iron grade FG 220. This casting was produced in a medium scale foundry using green sand process in machine moulding. The root cause for this major defect was identified through defect diagnostic study approach. Finally, by taking necessary remedial actions the total rejection rate was reduced to 4% from 28%.
Keywords: sand mould, mould crush, cause and diagram , Pareto chart

1. INTRODUCTION

Large tonnage of castings is produced in sand moulding process. Green sand moulding process continues to be the most widely process for moulding among the sand moulding processes. The reusability of the sand is the major advantage of this process. The major benefit of this process is inexpensive and can easily be automated. In this paper an automobile casting (Cast Iron Grade FG 220) with mould crush as the major defect is analysed using defect diagnostic approach.[1,4]

2. 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/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 major rejected automobile casting was analysed using defect diagnostic approach as shown in the Fig1. [5,7]

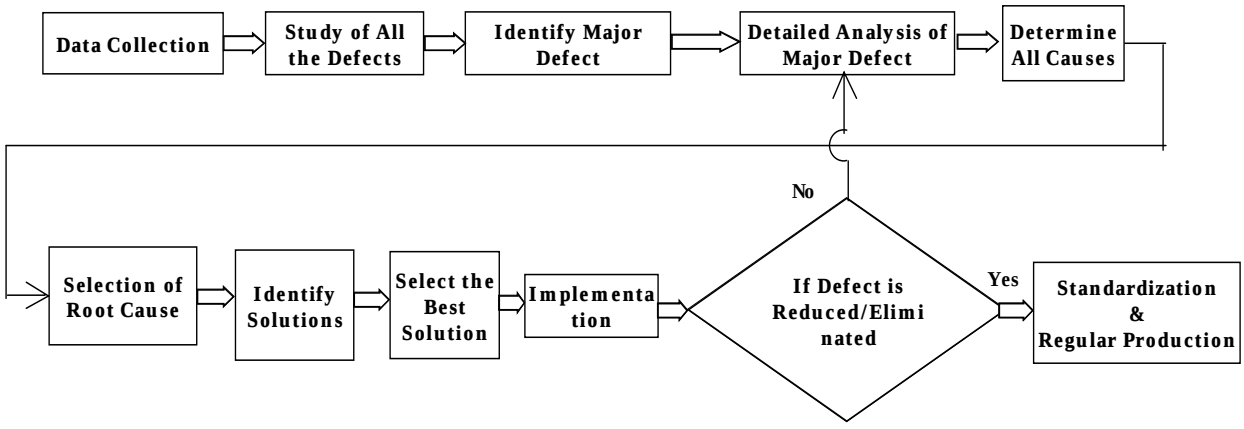

Figure 1. Defect diagnostic approach

3. PRELIMINARY STUDY

The study was made in a medium scale foundry producing many varieties of castings. The rejection in automobile transfer case casting is a major problem among the many castings produced in this foundry. This major defect is analysed and solved by using the defect diagnostic approach is presented in detail.

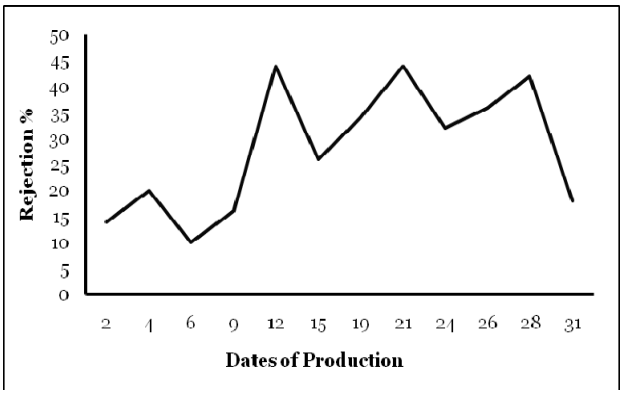

Figure 2. Monthly production rejection data

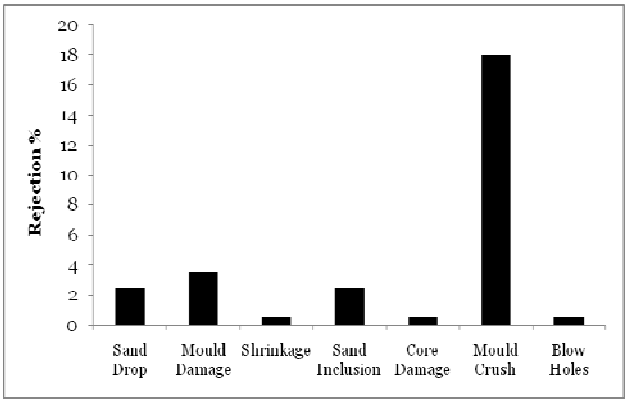

Figure 3. Major casting defects in a month

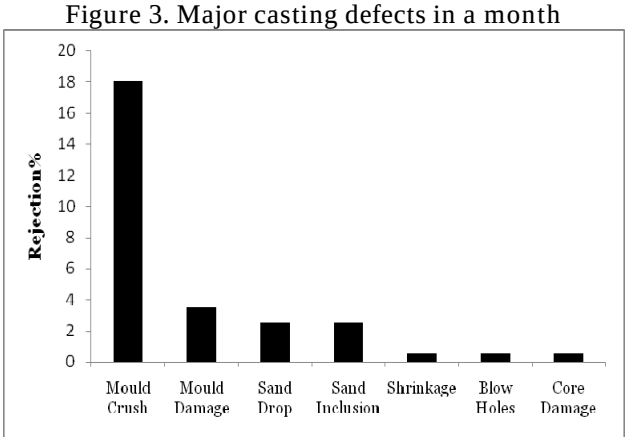

Figure 4. Major casting defects as Pareto chart

4. DATA COLLECTION

The rejection data for a month period were collected and drawn as line graph is shown in the Figure2. The total rejection percentage for this casting varies from 10 %to as high as 45 %. The rejections were distributed to all the days of the production.

5. STUDY OF ALL THE DEFECTS

The next step in the analysis is to study all the casting defects occur in the castings. The bar chart was drawn using the rejection data of the month is shown in the figure 3.

6. IDENTIFY MAJOR DEFECT

A Pareto chart is drawn using the rejection data of this casting is shown in the Figure 4. It is very clear from the figure that the mould crush defect is the found to be the major defect among all the defects.

7. DETAILED ANALYSIS OF THE MAJOR DEFECT

The detailed analysis of this major mould crush defect is made in this step. It is essential to know whether the mould crush defect was occurring in particular days of production or it was distributed to all the days of production in the study period. A bar chart was made for this major defect for all the days of production as shown in the figure 5. The figure 5 depicts that the mould crush defect was distributed over all the days of production.

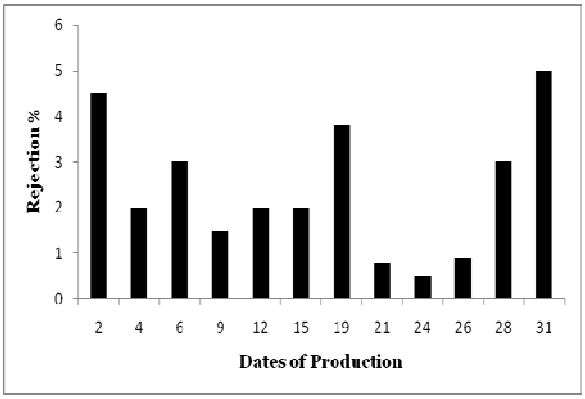

Figure 5. Distribution of major defect

8. DETERMINE ALL CAUSES

The mould crush defect appears as indentation in the casting surface due to the movement of sand in the mould. The possible causes for this defect due to various tools and processes are shown as cause and effect diagram in figure 6.[1-4,8-11]

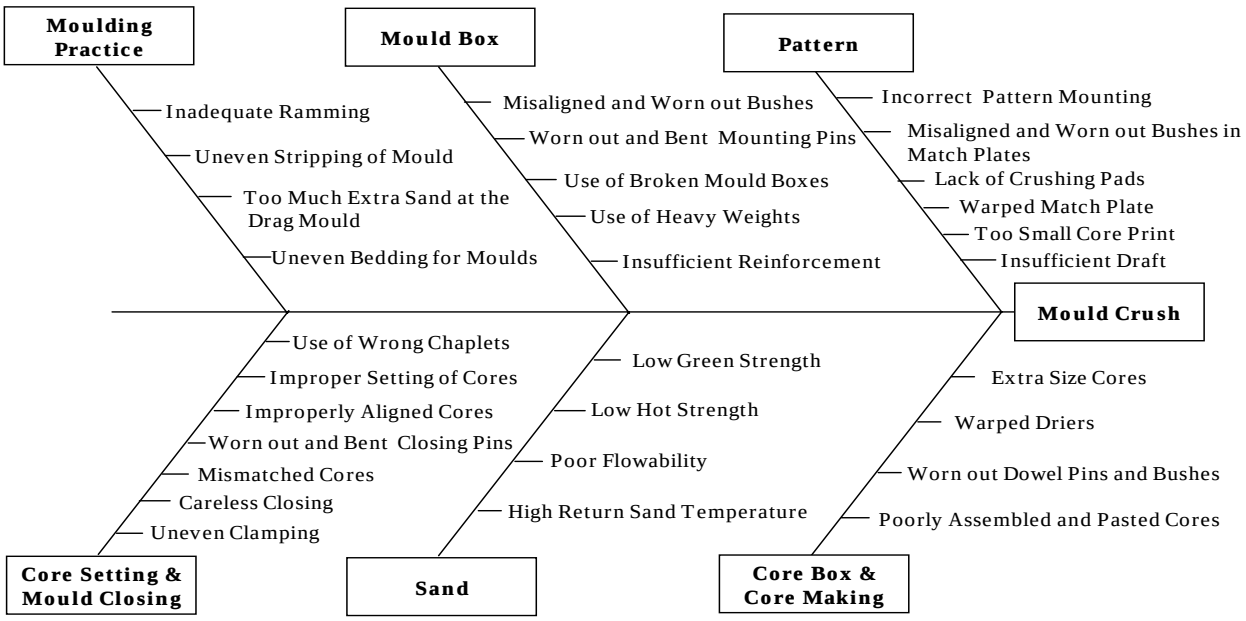

Figure 6. Cause and effect diagram for mould crush defect

9. SELECTION OF THE ROOT CAUSE

The detailed examination of rejected castings is required to identify the root cause for this major mould crush defect. The casting is divided into 10 zones according to the appearance of this defect in the rejected castings. The zones marked as 'c' in the core prints of the cope pattern denotes defect is in the cope side of the casting where as 'd' denotes, the defect is in the drag side. The cope and drag patterns fixed on the match plate is shown in the figure 7 and figure 8 respectively.

The distribution of the defects is shown in Figure 9 and Figure 10 respectively.

Based on figure 9 and figure 10, the mould crush defect is distributed in all the marked zones of the casting. Initially, both the match plates were checked for mismatch or loosening of patterns. It was found that there was no mismatch or loosening of patterns.

Then the core box and core making process was analyzed in detail. After thorough analysis of core making process, it was found that the split core box was separated into two halves and cores were taken separately using sodium silicate process. Initially both halves of these cores were aligned and pasted together to form a single core and finally these cores were used in moulding. After through investigation of the core making process, finally it was found that the mismatch in cores caused during pasting was the root cause for this defect.[10-15]

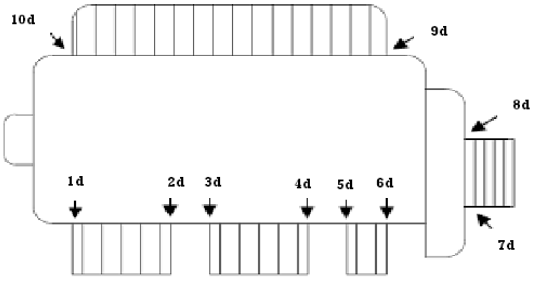

Figure 7. Transfer case pattern– drag part

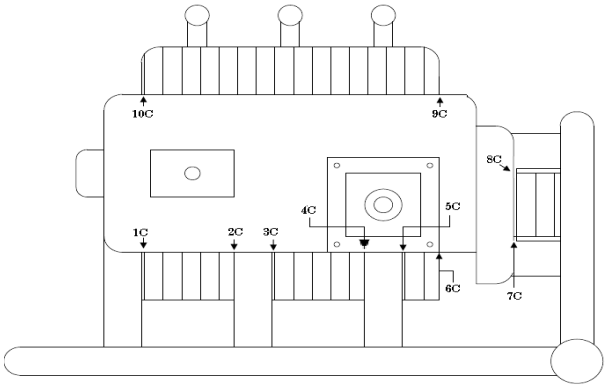

Figure 8. Transfer case pattern– cope part

10. IDENTIFY SOLUTION

This major mould crush defect can be reduced only by avoiding mismatch in cores. This may be accomplished in many ways:

- Thorough inspection and rejection of the mismatched cores
- Use of only skilled labours for aligning and pasting of two halves of cores
- Use of fixtures for aligning and pasting of cores
- Providing crush pad in the drag side core prints of the pattern
- Producing core as a single core, eliminating aligning and pasting works

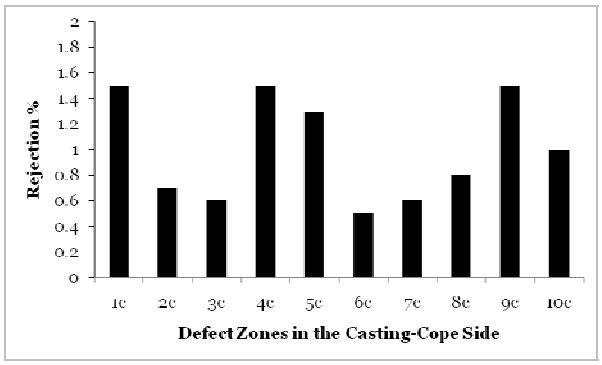

Figure 9. Distribution of defects – cope side

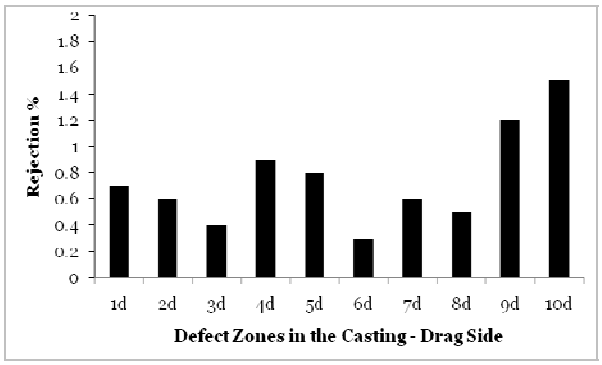

Figure 10. Distribution of defects – drag side

11. SELECTION OF THE BEST SOLUTION

Production of cores as a single core was selected as the best solution among the many solutions presented.

12. FINAL RESULT

Implementation

The required modifications were made in the core box to take the core as a single core. A trial production was made using the single core and found that the mould crush defect was totally eliminated in this casting and the total rejection was reduced to 4%.

Standardization

The modification made in the core box to produce core as a single core was standardized.

Regular Production

The cores taken in the modified core box were used in the regular production.

13. CONCLUSION

The correct identification of the casting defect at the initial stage is essential for taking remedial actions .This paper presents the systematic approach to find the root cause of a major defect (mould crush) in an automobile casting produced in a medium scale foundry. The origin of the mould crush defect was identified by means of analyzing tools and processes using defect diagnostic approach as well as cause and effect diagram. Finally, it was found that the core was the root cause for this major defect. The necessary remedial action was made in the core box to take the core as a single piece. The major mould crush defect was totally eliminated after using single core in regular production. The total rejection was reduced to 4% from 21%. This systematic study proves that by means of effective analysis of tools and processes, it is possible to eliminate/control the casting defect.

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