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ALLUMINIUM AND CAST IRON CASTING DEFECTS COMPARISON ANALYSIS AND REMEDIES

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Abstract – *Nowadays industries plays important role in the national development. So it necessary to produce good quality of products as per acceptable standards. During basic manufacturing process defects free casting production depends upon selection type of material, casting conditions majorly based on the application where the product is used. The design of casting based on strength, damping property and sustainability during prolong period of time. At the same time there is chance that rejections of casting due the hidden defects due variations in composition differ from product to product based on the different design conditions. Therefore it is necessary to have at least few material comparisons to know their manufacturing difficulties for minimize rejections of casting to enhance safe design and development conditions.*

Key Words: Design, Development, Casting, Manufacturing, Damping, Material.

1. INTRODUCTION

In order to optimize the manufacturing conditions for production of different type of casting products it is necessary to understand the behavior of the molten metal under working conditions. The material composition differs based on the mechanical, electrical, chemical, magnetic properties etc.at end use of product. The manufacturing conditions of Cast Iron alloy castings were differ from the aluminums alloy castings. The aluminums alloys castings have the more manufacturing fusibility than Cast Iron alloy products due to their less density, good flow ability, and low melting boiling temperature comparatively. The other parameters like pouring time pressure, temperature, solidification time and time of ejection of casting from the die. These parameters need to optimize to enhance defect free castings under different operational work personals. Also there is chance of getting hidden defects based on the structure, alloy composition, design aspects which restricts the easy flow of molten metal to occupy mold need to focus. During solidification molten metal at the sharp corner may not filled to variation in temperature at the inner surface and outer surface due to different rate of solidification shrinkage. Comparison of study of different materials is necessity to achieve common goal of getting sound castings for under different design conditions for different types of materials.

2. PROBLEM FORMULATION

Castings with more common defects in aluminums and cast iron castings data were compared to observe more significant defects in manufacturing were due to manufacturing difficulties based on their applications. And common defects remedies were determined to get sound castings with ease in manufacturing.

3. METHODOLOGY

Kind of defects arises during manufacturing of both aluminium and cast iron castings were studied and few months data is compared. And defects with more significant occurrences were focused to determine the manufacturing difficulties and the common remedies to avoid the future repetitions. Conclusion is made with the material with its suitability regarding its operational conditions.

4. ALUNIUM CASTINGS.

Study is conducted for the Breaking bracket aluluminium alloy component in the year 2024

Type of defect	Quantity of rejections	Percentage of rejections
Shrinkage	8950	34.53
Blow holes	7061	27.24
Unfilling	3130	12.07
Rubbing	1954	7.54
Diecoat	1822	7.03
Crack	1421	5.48
Inclusion	563	2.17
Damage	421	1.62
Pinhole	273	1.05

4.1 Pareto chart analysis for Aluminium alloy Breaking bracket component.

A pareto chart demonstrates the most common defects in the casting process. It also explains the defect's contribution as well as cumulative defects contribution for each defect. As per pareto 80% of problems will be solved by 20% solutions. For this instance 5 types of defects viz. shrinkage, blowhole, unfilling, Rubbing and die coat cumulatively contributes 88% of the defects. If root causes and remedies for these defects can be analysed and implemented then 90percentage can be minimised. This study focuses on most common defect and their remedies to minimize the rejection rate of the casting components.

4.1.1 Shrinkage defect

Fig1. Image of Shrinkage defect

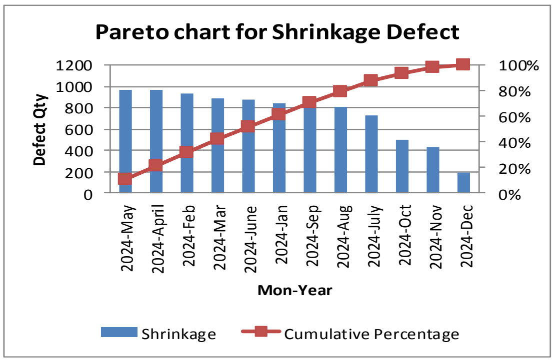

Fig.2. Pareto analysis for Rejection of component due to shrinkage defect.

Pareto chart for shrinkage defect explains how frequently The shrinkage defect occurs. It is caused by volume reduction during solidification results in voides or porous zones on the surface.

Remedies: Optimize riser size and location so that allowing molten metal to feed to mould continuously and it has to freeze last. Insert chills in thin sections to promote directional solidification. Maintain mould temperature properly to prevent premature solidification.

4.1.2 Blow hole defect

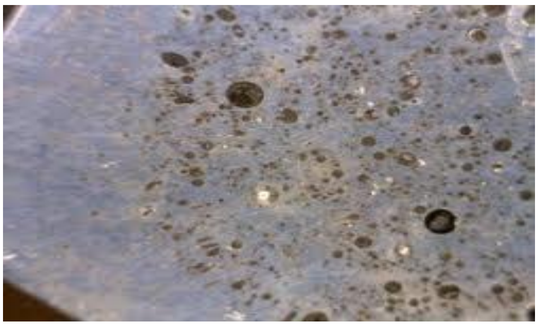

Fig.3. Image of Blow hole defect

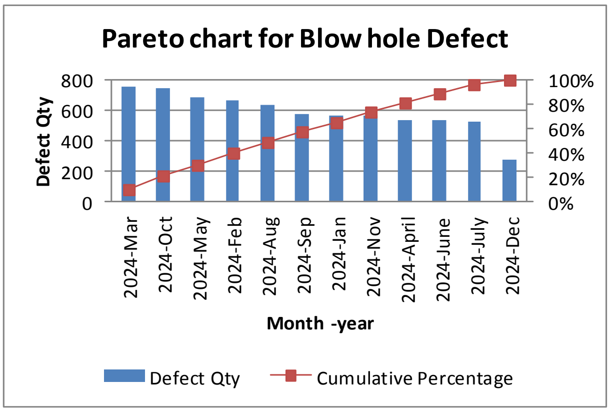

Fig 4. Pareto analysis for Rejection of component due to Blow hole defect.

Pareto chart shows how frequently blow hole defect occurs continuously. Spherical or rounded cavities due to entrapped gas during solidification.

Remedies: It can be minimized by controlling sand moisture in the mold, increasing number of vents and Optimizing pouring parameters like velocity, temperature to reduce turbulence during pouring.

4.1.3 Unfilling defect

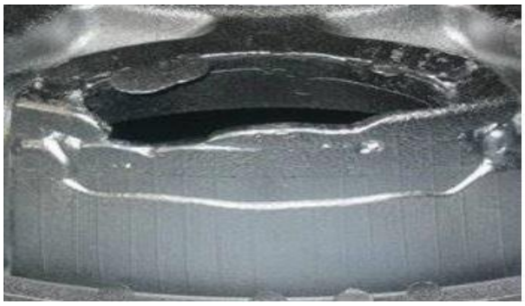

Fig.5. Image of Unfill defect

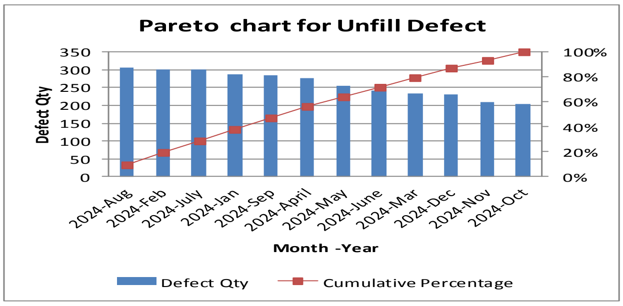

Fig.6. Pareto analysis for Rejection of component due to Unfilling defect.

Pareto chart shows how frequently Unfill defect occurs when molten metal fails completely to fill the mold cavity and leaving incomplete parts. It is caused by low metal fluidity, low pouring temperature, improper gating design.

Remedies: It can be reduced by enhancing fluidity, Improving gating system, Increase section thickness to prevent premature freezing.

4.1.4 Rubbing defect

Fig 7. Image of Rubbing defect

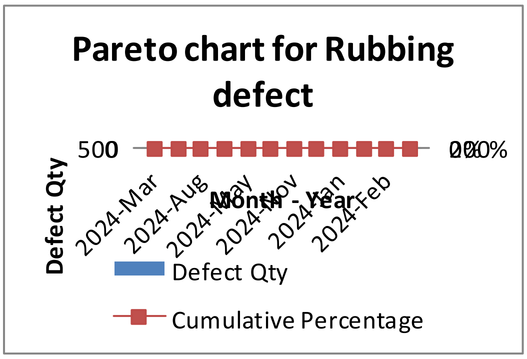

Fig 8. Pareto analysis for Rejection of component due to rubbing defect

Pareto chart shows how frequently rubbing or sand inclusion defects occurs frequently. Surface irregularities due to rubbing of mold by molten metal. Irregular projections accompanied by depression appear on the casting surface.

Remedies: It can be reduced by Better design of gating system, better ramming, using high quality sand and reduce moisture content in sand. Improve the design of the runner system to control the turbulence.

4.1.5 Die coat defect

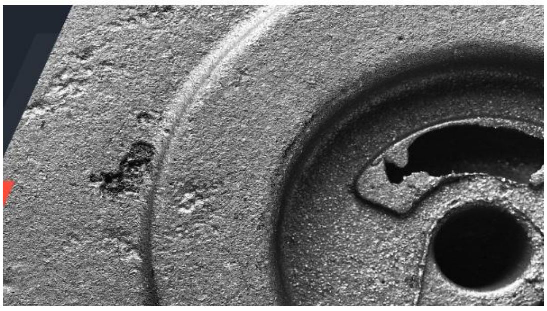

Fig9. Image of Die coat defect

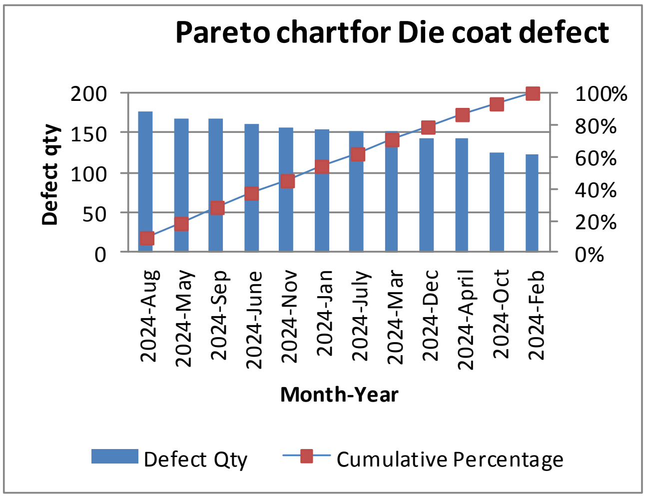

Fig 10. Pareto analysis for Rejection of component due to Die coat defect

Pareto Chart shows how frequently die coat defect occurs it is due to surface bleminesh, reacting of alluminium molten metal with die material.

Remedies: Ensure die is not too hot or too cold Optimized die coat is used. Controlling the concentration of die coat based on temperature. By using automated sprayers for even coating. By regularly cleaning and treat the die with appropriate coating this defect can be minimized.

5. Cast Iron Casting

Study is conducted for the Trumpet Housing Cast iron component of Tractor for the year 2024

Type of defect	Qty. Rejections	% of Rejections
Blow holes	364	39.9
Sand drop	150	16.4
Porosity	138	15.14
Depression	105	11.52
Scab	37	4.06
Box lift	28	3.07
Core lift	27	2.96
Shot pour	23	2.52
Mismatch	14	1.53
Broken casting	13	1.42
Leakage	12	1.31

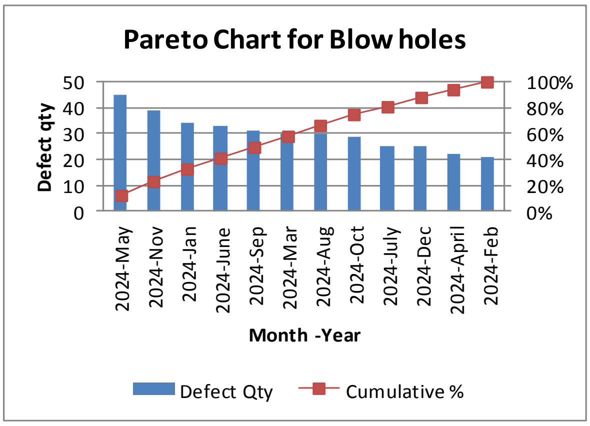

Fig 11. Pareto chart for Blow hole defect

Pareto chart shows how frequently the blow hole defect occurs due to entrapped gases during solidification.

Remedies: It can be minimized by controlling sand moisture in the mold, increasing number of vents and Optimizing pouring parameters like velocity, temperature to reduce turbulence during pouring.

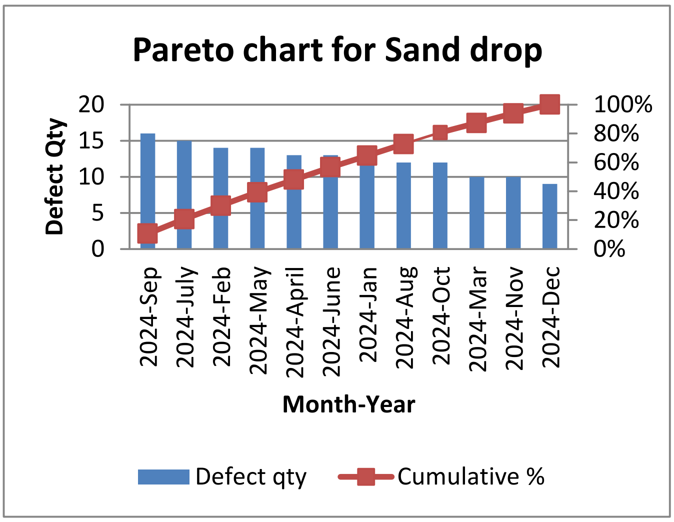

Fig 12. Pareto chart for sand drop defect

Pareto chart shows how frequently Sand drop defect occurs due drop of mold sand in the molten metal results in sticking of sand on casting surface unfill surface appears as after sand blasting.

Remedies: It can be reduced by Better design of gating system, better ramming, using high quality sand and reduce moisture content in sand. Improve the design of the runner system to control the turbulence.

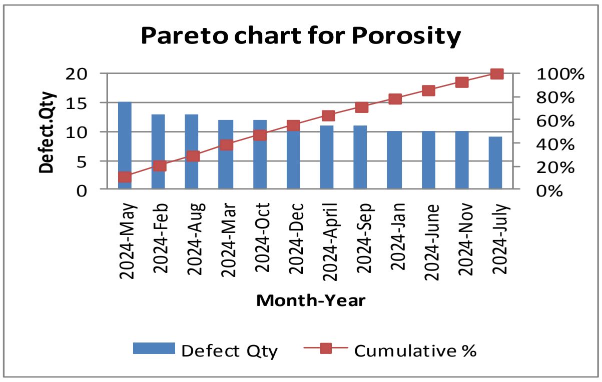

Fig 13. Pareto chart for Porosity defect

Pareto chart shows how frequently porosity defect occurs small tiny holes appears on the casting surface due to entrapped gases which were not escaped during solidification.

Remedies: Proper and sufficient number of vent holes, adequate design of runner and gating system, proper control of the sand composition.

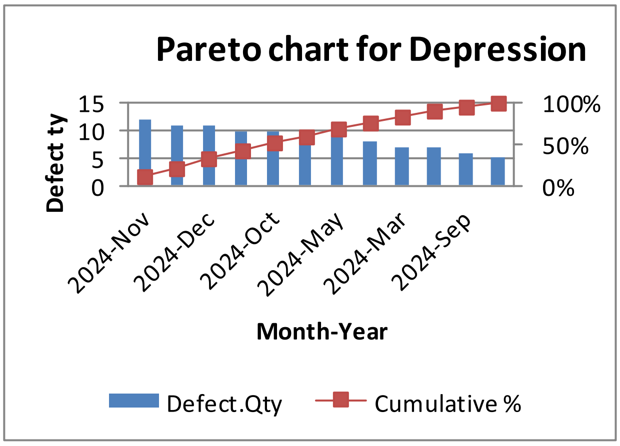

Fig 14. Pareto chart for depression defect

Pareto chart shows how frequently depression defect occurs it is due insufficient supply of molten metal during solidification. When molten metal contracts early freezing occurs in the casting.

Remedies: Optimize riser size and location so that allowing molten metal to feed to mould continuously and it has to freeze last. Insert chills in thin sections to promote directional solidification. Maintain mould temperature properly to prevent premature solidification.

6. Alluminium and Cast Iron Casting common defects Analysis

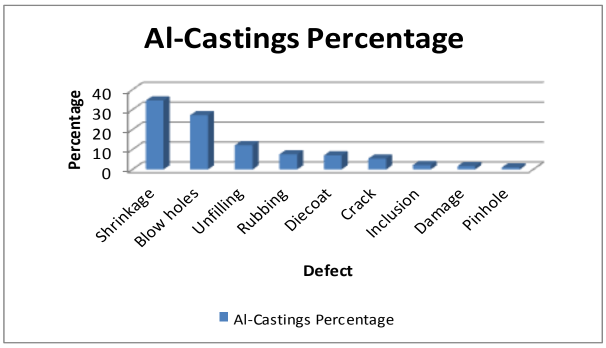

Fig 15. Al Casting percentage of defects

Graph shows 88% of casting defects occurs due to shrinkage, blow holes, unfilling, rubbing and die coat. It can be minimized by proper control of process parameters, molding pouring conditions.

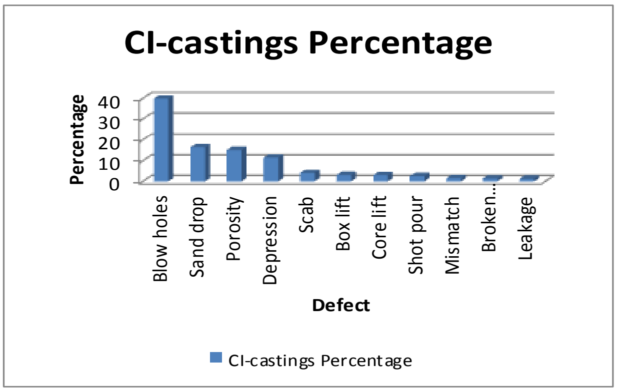

Fig 16. Cast Iron Casting percentage of defects

Graph shows rejection percentage of cast iron castings. Majorly 82 percentages of rejections occurs due to blow hole, sand drop, Porosity, depression (shrinkage). These can be minimized by controlling minimum parameters

7. CONCLUSION

By applying the Quality Control Tools defects can be studied which include their monthly rejection analysis and using brainstorming final solution is made for eliminating the defects which after being applied to the production process lead to significant reduction in the percentage rejection thus reducing costs and making profit for the industry.

If we properly design runner, riser, gating system, casting temperature parameters, mould design parameters we can control 80 percentages of rejections contributing in reducing the production cost to minimal.

Aluminium is light weight material has more fluidity can occupy mould easily by giving radius at the corner of molud unfilling defect can be avoided. By proper designing riser to supply molten metal during solidification shrinkage problem can be minimized.

Cast iron is heavy material by proper chemical composition fluidity can be controlled. By proper design of runner gating system unfilling, shrinkage defect can be controlled. By proper design of mould cavity and venting sand drop and gas porosity can be controlled.

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