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Experimental Study of Casting using Loose Piece Pattern(Dovetail)

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Abstract:** One of the earliest metal-shaping techniques used by humans is casting. Typically, it entails pouring molten metal into a chamber of a refractory mould that has the desired shape before letting it cool and solidify. When the desired metal product has formed, the refractory mould is broken or disassembled to release it. When it is impossible to remove the pattern from the mould due to the part's shape, a loose piece pattern is employed. Casting faults should be decreased in order to improve the quality and productivity of any company. It is a procedure that results in some defects that give the intended producta chippier quality.

Keywords:** Casting, Refractory, Loose Piece Pattern, Defects and Remedies.

1. INTRODUCTION

Casting is the process of pouring molten metal into a mould that has a hollow chamber in the desired shape, letting it cool, and allowing it to solidify. A casting, which is the term for the solidified component, is expelled or broken out of the mould to finish the procedure. Casting is most frequently used to create intricate forms that would be challenging or expensive to create using alternative techniques.

The most popular casting method, called sand casting, creates intricate metal pieces from virtually any alloyusing disposable sand mould. Sand casting normally has a poor production rate since the sand mould must be destroyed in order to extract the part, known as the casting. A sand mould, metal pattern, and an oven areall used in the sand casting process. The pattern-formed chamber of the sand mould is filled with the metal after it has been melted in the furnace and squeezed. The hardened casting may be removed when the sand mould separates

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along a dividing line.
A pattern is used to create the hollow in the sand. The aggregate containing the hollow is kept in a flask, which is a container. Small protrusion or cantilevered sections may occasionally be present in the casting. It is challenging to take the pattern out of the mould because of these protrusion. These projections are created as isolated pieces as a result. They are only tangentially joined to the main portion of the design, and the mould is created as normal. Loose bits slide out and stay in the mould when the main pattern is taken out of it. The individual elements of the pattern are removed after the main body has been taken out, and they are then lifted into the empty area left by the main pattern.

There are a number of casting process flaws, including blow, pinhole, drop, shrinkage, and many others. Although it cannot be completely eliminated, it can be lessened. It can be located and diminished via a machining procedure. These flaws might be caused by any of the following:
1. Lack of pattern allowances
2. Improper melting practices
3. Improper gating system
4. Improper mould constituents

Literature Review
In the reviewed paper by T. R. Vijayaram et al. (2010), some of the solutions and features of quality control are given simply to remove any ambiguity for the foundry industrial staff who operate in the casting manufacturing quality control departments. Young manufacturing and mechanical engineers who are interested in beginning their careers in the manufacturing concerns of medium- and large-scale captive foundries may find the material in this review paper to be of great use.In casting rejects, D.N. Shivappa et al. (2012) identified four noticeable flaws. They discovered that some castings of the Trunion Support Bracket (TSB) typically had flaws such sand drop, blow holes, mismatch, and oversize. C.B. Patel and Dr. H.R. Thakkar (2015) examined research projects undertaken by numerous researchers with the goal of reducing a variety of flaws and enhancing production. They come to the conclusion that quality tools are crucial to decision-making during the defect analysis. In order to reduce casting rejection owing to severe defects, Vivek V. Yadav and Shailesh J. Shaha (2016) reported study work done in foundries. The single cylinder head is having an issue. The study focuses on analyzing the blow hole defect since it has a greater impact on the overall rejection rate. To determine the true causes of the blow holes, a root cause analysis is conducted as part of the quality analysis process. Analysis is done using quality control techniques such Pareto analysis, Cause and Effect (Ishikawa) diagrams, and Why-Why analysis. Corrective and preventative measures are accordingly recommended and put into practise. The process control check sheet is updated to include a check point for central gas vent cleaning, and process compliance is added to reflect the application of wet green sand to the central gas vent during mould box construction. Sushil Kumar et al. (2011) examined casting faults and came to the conclusion that Six Sigma, or the (DMAIC) technique of parameters, may increase quality at the lowest feasible cost. It is also feasible to determine the ideal signal strength levels at which noise components have the least impact on the response characteristics. Their case study has led to the optimization of the green sand

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casting process's operating parameters, which helps to reduce casting flaws. Moisture content (4.0%), green strength (1990 g/cm2), pouring temperature (14100C), and mould hardness number vertical & horizontal (respectively 72 & 85) are the ideal parameter levels for the green sand-casting technique. According to Sunil Chaudhari and Hemant Thakkar, the goal of this study is to analyse the research done by other researchers in an effort to find technological solutions for reducing different casting flaws and to enhance the complete casting manufacturing process. The industrial industry has particularly benefited from the modern approach of casting components employing different software and simulation techniques. It provides a variety of benefits and acts as an intelligent tool to improve the cast component's quality. This will undoubtedly aid in raising the casting's yield and quality. When castings are examined in this technologically advanced manner, it puts foundry workers on high alert to prevent rejects. According to Achamyeleh A. Kassie, Samuel B. Assfaw, this effort is meant to focus on just two of the serious steel casting flaws, namely gas flaws and shrinkage flaws. Four process factors, including the sand- binder ratio, mould permeability, pouring temperature, and deoxidant quantity in three levels, were investigated in order to reduce these faults. A factorial experiment was conducted to get representative experimental data. According to Udhaya ChandranR. M., the major goal of this research was to reduce casing flaws including blow holes, sand drop scabs, and pinholes. a method of process parameter optimization for greensand casting.

Experiment Details
Pattern making
One of the earliest and most crucial processes in the casting process is the creation of the patterns. The pattern is a copy of the item that will soon be cast. Patterns are often constructed of wood, metal, or model board and used to make cavities in mould.. We use wood as a material for pattern making because wood is easily available, cost effective and can be designed to any shape easily. In this experiment, we made a loose piece pattern for casting as it can be used for designing very complex shape or projections.

Sand Preparation
Sand is used in the foundry business to create moulds. Three mullers are employed in this sector to mix sand with other ingredients including water, bentonite, and other materials. Every step of the mulling process, including the sand insertion, is carried out by hand. Sand

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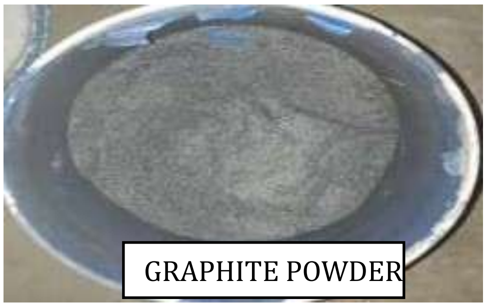
characteristics are therefore improperly obtained as a result of this manual process, and less prepared sand is produced overall. The entire output of mould boxes is therefore affected.



Mold Making

A mould is nothing more than a tiny chamber into which molten metal is poured to create a casting of the desired shape. Mold manufacturing is the practice of preparing a mould assembly for use in a product. A crucial step in the sand casting process is the creation of the mould. This mold-making procedure is carried out manually in the foundry sector using hand-operated instruments. Manual steps include arranging the pattern, creating the mould box, inserting the sand, installing the gating system components, pushing the sand into the mould box, and creating the mould assembly. Cope and drag moulds are used in organizing.

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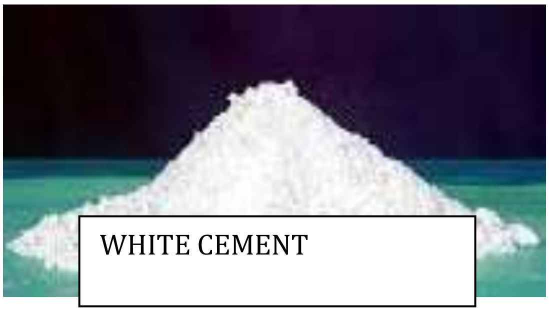
Pouring

Pouring is a foundry procedure that simply involves pouring molten metal into mould to create castings. Pouring section includes ladles which are used to pour the molten metal in molds. Prepared molten metal is poured in ladles which are taken away to pour into molds manually. In industry four hand ladles are there which are used to pour molten metal in mold box.Firstly, we use white cement as a molten liquid to cast the product and then we uses aluminum molten metal to get our desired product.



Shakeout

After molten metal has been poured into mold boxes it is permitted to cool and solidify. When the casting has solidified it is removed from molding box. This operation is marked as Shakeout. In organization shakeout is also done manually. The process like dump the mold assembly upside down on ground. Break the sand around the casting by striking against the sand with the back of hammer, the casting can then be pulled out of the sand with the hook bar etc .so all is donemanually.

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Casting Defects:

Mismatch

Mismatch in mold defect is due to shifting of molding halves. At the parting line, it will result in thedislocation.

Causes

The cope and drag components of the mould must stay in the correct positions or there will

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be a mismatch. This is brought on by frayed box pins, incorrect design dowel pins, or hasty application of the cope to the drag.

Remedies

Make sure the pattern mounting on the match plate is right, and then adjust the dowels.
Employ the suitable closure pins and moulding box.

Gas porosity

Due to trapped bubbles during solidification, castings are porous. other causes include dissolved gases from melting, dross or slag, and gas porosity in dross or slag. Air that has been trapped, hydrogen that has been dissolved in aluminium alloys, moisture from water-based die lubricants, or steam from damaged cooling lines can all produce gas.

Causes

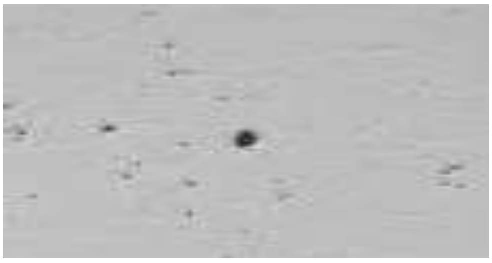
Low metal pouring temperature, insufficient metal fluidity, and sluggish pouring

Remedies

Increase the temperature at which metal is poured; change the composition of the metal to increasefluidity; and pour the metal as quickly and continuously.

Blowhole

A rounded or oval-shaped hollow cavity with an oxide association forms when metal solidifies on a metal surface that is smooth or clean. It forms a bubble that blocks the liquid metal from filling the high spots of a mould cavity. A type of cavity defect known as a blowhole is also known as apinhole and a subsurface blowhole. A pinhole is a little hole. After milling, the blowhole is only visible below the surface.



Causes

Low pouring temperature when casting; insufficient venting core of the mould; excessive gasrelease permissibility; excessive moisture absorption by the cores;

Remedies

Reduce the amount of binder, improve the venting core of the mould, and create venting channels.

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2. RESULT AND DISCUSSION

Because pouring system and temperature affect several flaws, such as shrinkage, porosity, and cold shut/Mis run, maintaining a pouring temperature between 1418 and 1432 oC will assist to minimise alldefects. The pouring system may be automated extremely effectively.
The moulding will need to be replaced by automation, however if air blasting rammers are utilised to keep mould hardness within range, it reduces faults like crushing, Fins/flash creation, and mould shifting byup to 50%.
With different sand qualities, the fault surface finish and porosity are also reduced. Therefore, thoroughsand mulling is necessary, along with the addition of the right amount of additive.

3. CONCLUSION

This article discusses casting faults with a particular emphasis on case studies. The numerous causes and corrective actions are recommended by applying the cause and defect analysis concept. This study will be very helpful in lowering casting faults in industries and raising casting quality while minimizing casting rejects. It will be very helpful to foundry experts in enhancing casting yield.
This study outlines systemic methods for identifying problems caused by manual processes. Finally, it was discovered that some ignorance and carelessness were present in the hand metal casting procedures.
Therefore, offering additional corrective measures and putting them into practice where possible decreasestotal rejection by more than 30%. Complex form casting benefits greatly from loose component patterns. We may simply project any complex form or contour by employing a loose piece pattern

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