Improve The Feeder Efficiency By Adding Exothermic Material In Riser (Sleeve)

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Abstract- *Metal casting manufacturing is the basic principle and important in casting industry. To improve the productivity the feeder should be efficient enough for the cast to be produced efficiently with no defect. Defects are the main problem in casting industries. In order to reduce such defects like shrinkage, hot tears, blow hole, pin hole etc., the feeder effectiveness should be improved and maintained. For improving the feed efficiency sleeves like ISC sleeve, Foseco sleeve and in addition of sand riser are tested to find which casting is better to produce in a high economical value without upsetting the quality. Accordingly, by this analysis to improve the feeder efficiency without affecting the quality it would help the company to make good quality products and thereby reduce the rejection level of products.*

Keywords- Steel Casting, Riser sleeves, Sand casting, casting yield

I. INTRODUCTION

Cast iron refers to a class of iron-carbon alloys with a carbon concentration of more than 2%. Its utility stems from the fact that it melts at a comparatively low temperature. White cast iron has carbide impurities, which allow cracks to pass straight through, grey cast iron has graphite flakes, which deflect a passing crack and initiate countless new cracks as the material breaks, and ductile cast iron has spherical graphite "nodules," which stop the crack from progressing further.

The major alloying constituents of cast iron are carbon (C) ranging from 1.8 to 4% by weight and silicon (Si) ranging from 1-3 by weight. Steel is a kind of iron alloy with a low carbon content (less than 0.8%). Although the Fe-C-Si system is technically ternary, the mechanism of cast iron solidification may be understood using the binary iron-carbon phase diagram. Because most cast irons have compositions near the eutectic point (lowest liquid point) of the iron-carbon system, melting temperatures typically range from 1,150 to 1,200 °C (2,100 to 2,190 °F), which is about 300°C (540°F) lower than the melting point of pure iron, which is 1,535°C (2,795 °F).

Ductile cast iron is yet another type of ferrous alloy that is used as an engineering material in many applications. To produce ductile iron, small amount of magnesium is added to the molten iron, which alters the graphite structure that is formed. The magnesium reacts with oxygen and Sulphur in the molten iron leading to nodule shaped graphite that has earned them the name-nodular cast iron. Like malleable iron, ductile iron is flexible and exhibits a linear stress strain relation. It can be casted in varied sizes and into varying thickness. It is designate by SG followed by the numbers which indicate tensile strength and percentage elongation.Spheroidal graphite (SG) cast iron was discovered in the 1948. However, if coke (which is high in sulphur) had not been used for melting iron and if high purity ores had been used, then ductile iron would have been accepted as the normal form of iron, with flake graphite iron only being discovered much later as an accident of adding S and O This seems to have been close to the situation in China where spheroidal graphite irons were produced over 2000 years ago.

During the process of manufacturing, internal shrinkage was found to occur in the corners and sides of the cast. After sectioning the corners and sides of the cast, the defect can be visible. This defect affected the casting yield, and the company was falling short of achieving its target. We were asked to work on this problem to find which sleeve helps improve feeding efficiency.

II. DEFECTS FOUND IN SAND CASTING

The common defect occurs in that sand mould casting:

1. Shrinkage
2. Pouring metal defects
3. Gas porosity
4. Pouring metal defects

Shrinkage defect is one of the most severe sand-casting defects that lower the casting quality. Here casting shrinkage defects happen as the shrinking process occurs unevenly resulting in shrinkage cavities in the casting parts. Two types of shrinkage casting defects are close shrinkage defects and open shrinkage defects.

Miss runs, cold shuts, and inclusions are all common pouring metal flaws. When liquid metal does not entirely fill the mould cavity, a miss run occurs, leaving an empty part. When two fronts of liquid metal fail to merge effectively in the mould cavity, a weak area result. Both are produced by a lack of fluidity in the molten metal or by overly thin cross-sections. The fluidity of the metal can be improved by altering its chemical composition or raising the pouring temperature. Back pressure from inadequately ventilated mould cavities is another probable reason.

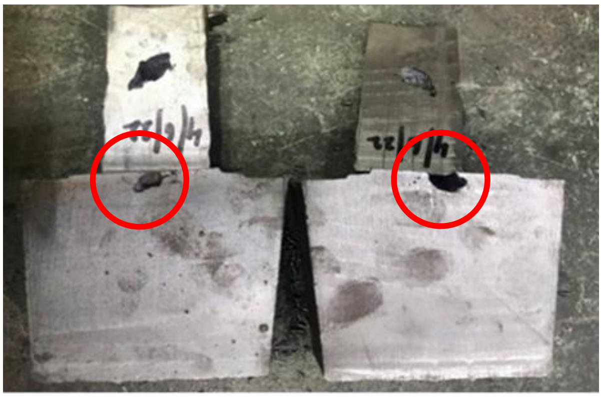
Gas porosity is another popular sand-casting defect mostly seen in the metal casting process. Gas porosity is bubbles created within the casting after the cooling step. Gas porosity casting problems come in three types of bubbles that are pinholes, blowholes, and open holes.

Mould material defects, the sand-casting process uses naturally bonding sand mould that arises casting defects relating to the mould. Mould material defects are problems resulting from moulding material and mould design.

Metallurgical defect there are two defects in this category: hot tears and hot spots. Hot tears, also known as hot cracking, are failures in the casting that occur as the casting cools. This happens because the metal is weak when it is hot and the residual stresses in the material can cause the casting to fail as it cools. Proper mould design prevents this type of defect. Hot spots are areas on the surface of casting that become very hard because they cooled more quickly than the surrounding material. This type of defect can be avoided by proper cooling practices or by changing the chemical composition of the metal.

III. PROBLEM IDENTIFICATION

During the process of experimenting the cube which is made with sand riser, internal shrinkage was found to occur in the inside of the cast. After cutting the cube vertically the defect was visible. This defect affected in the sand riser was identified. The ISC sleeve and foseco sleeve was more efficient.



Internal shrinkage found in sand casting

In the foundry it is difficult to produce defect free casting. Thus the most major type of defect is the shrinkage defect. The causes for the Occurrence of the shrinkage in the castings are as follows

1. Metal conditions
    a. Differential cooling
    b. Flow rate
    c. Magnesium treatment
    d. Metal temperature

2. Materials
    a. Chemical composition
    b. Effects of alloying

3. Gating method
    a. Fluidity of metal
    b. Uniform part thickness
    c. Fillers and riser

4. Pouring
    a. Pouring velocity
    b. Pouring height
    c. Pouring time

These causes could be clearly visible through the cause and diagram

Solution

During casting many defects may occur. To reduce the casting defects riser sleeve can be used. The exothermic insulating property shown by the sleeve helps to improve the feeder efficiency.

Casting Experiments

The tests and findings are described here in order to provide an overview of the procedures utilized to obtain and determine sleeve property data. The studies mentioned in this study were carried out using Indo Shell Cast (ISC) sleeve (black sleeve) and Foseco sleeve at Indo Shell Cast Private Limited (yellow sleeve). In addition to casting experimental measures with sleeves, a sand riser (no sleeve) experiment is also carried out.

A cube is used as a pattern for the casting, with the cube serving as the bottom layer and sleeves serving as the top layer through which molten metal is poured. The top and bottom moulds, which are visible from the top, are both 14 inches square and 2.75 inches thick and were utilized for all tests. The cube has a 90x90x90mm volume. Once the top and bottom layers are perfectly aligned, the molten metal is poured into the mould. At varying pouring temperatures, three trials are completed in total.

When SG Iron is poured into the three-moulds specified, it is done so at two different pouring temperatures: the initial pouring temperature and the final pouring temperature. Once the cast has cooled and knockout from the mould and it is shot blasted. Then, each cast is divided into two pieces and examined.

Riser Sleeve and properties

A riser, often referred to as a feeder, is a reservoir incorporated into a metal casting mould to avoid cavities brought on by shrinkage. Because castings shrink while they cool due to the fact that most metals are less dense as a liquid than as a solid, there may be a void where the metal is supposed to solidify last. By supplying molten metal to the casting as it solidifies, risers stop this from happening. As a result, the cavity develops in the riser rather than the casting. Risers are ineffective with materials that have a wide range of freezing temperatures because directional solidification is impossible. Additionally, they are not required for casting procedures that use pressure to fill the cavity of the mould.
Risers are only effective if three conditions are met the riser cools after the casting, the riser has enough material to compensate for the casting shrinkage, and the casting directionally solidifies towards the riser.

For the riser to cool after the casting the riser must cool more slowly than the casting. Chvorinov's rule briefly states that the slowest cooling time is achieved with the greatest volume and the least surface area; geometrically speaking, this is a sphere. So, ideally, a riser should be a sphere, but this isn't a very practical shape to insert into a mould, so a cylinder is used instead. The height to diameter ratio of the cylinder varies depending on the material, location of the riser, size of the flask, etc.

The shrinkage must be calculated for the casting to confirmthat there is enough material in the riser to compensate for the shrinkage. If it appears there is not enough material then the size of the riser must be increased.

Finally, the casting must be designed to produce directional solidification, which sweeps from the extremities of the mould cavity toward the riser. In this way, the riser can feed molten metal continuously to part of the casting that is solidifying. One part of achieving this end is by placing the riser near the thickest and largest part of the casting, as that part of the casting will cool and solidify last. If this type of solidification is not possible, multiple risers that feed various sections of the casting or chills may be necessary.

This standard covers the requirements for exothermic or insulating riser linings called sleeves in foundries.Sleeves are solid cylindrical shapes, essentially comprised of various refractory powders, high temperature resistant ceramic fibers and a binder system. Riser sleeves are an essential part of any sand and help improve feeding efficiency. Riser sleeves are vacuum formed and inserted into the sand to allow a reserve of liquid metal to be readily accessible to feed the casting, preventing shrink and piping.There are two types of sleeve, Exothermic Insulating Sleeve(The riser linings incorporate exothermic comounds in addition to normal insulating medium).Insulating Sleeve (The riser linings which are made of low density and refractory materials so as to provide insulation to the riser metal in mould).Type of material used in sleeveISC Sleeve is an exothermic insulating sleeve. Material used to manufacture ISC sleeve are themixing ingredients likeProtex-200 is exothermic and insulating sleeve powder, water4-6%, Sodium silicate, CO_2.

Exothermic riser sleeves are used to increase the solidification time of risers in sand casting operations. It is thereby guaranteed for risers to be the last solidified part between casted metal products containing gating parts. Thus, sound casting products that do not have cavity-like defects can be obtained.One of the most common justifications for utilizing a riser sleeve is increased casting yield. If a particular riser sleeve does not result in the usage of a smaller riser, utilizing that sleeve is superfluous and a waste of resources. It is crucial to specify what increases in casting yield can be made by adding riser sleeves. Long-standing problems, such as whether exothermic sleeves are more advantageous for smaller or greater riser diameters, can be resolved by examining the impact of sleeves on enhancing casting yield over a variety of casting sizes and shapes.

IV. CONCLUSION

The results of the experiment show that the sleeve is crucial to the cast's solidification in order to increase feeding efficiency. Foseco, Indo Shell Cast, and sand riser sleeves were all tried out.

Because of the shrinkage defect that is visible at the top of the cast when it is cut vertically in Trial 1, the ISC sleeve initially demonstrates more successful casting than sand riser. The Foseco sleeve has no defects but is similar to the ISC sleeve.

The sleeve was tested at the second try, trial 2, where ISC sleeve once more demonstrated a higher efficiency than foseco sleeve and sand riser. Foseco sleeves and sand risers both have the problem shrinking.

Finally, at trial 3, neither the ISC nor the foseco sleeves had any defects. Sand risers demonstrated the defect shrinkage.

Hence it is prove that ISC Sleeve improve the feeder efficiency similar to foseco sleeve but when comparing the economic value ISC sleeve is far more better than the foseco sleeve. Therefore ISC sleeve is best for casting.

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