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Precision Analysis and Control of Automatic Pouring Machine to Control the Flow ability To Minimize the Porosity of SG200 Casting for Foundry

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Abstract : In Zanvar Group Of Industries Pvt. Ltd Ashta is well known for making casting parts like brake drum, exhaust manifold, clutch plates etc. they are facing rejections due to casting defects of hotspot and porosity. Out of which porosity is major one. For reducing the porosity there are many ways like simulation technique , concept of E-foundry, changing gating and risering system etc. But apart from this we have come up with the new technique of automatic pouring machine. Among the automatic pouring machines the ladle tilt type machine is been widely used in East Asia. The paper discuss about the precession control and analysis of automatic pouring machine also how the defects can be reduced is discussed briefly.

Index terms: Porosity, Automatic pouring machine, E-foundry.

1. INTRODUCTION

As per literature survey it is reported that most of the defects occur due to the improper pouring of molten metal in mold. This can be reduced by implementing automatic pouring process. It is initially favored in East Asian nations particularly in Japan and China. Initially there were very few automatic foundries in India but now a days there are dozen of automatic pouring systems at indian foundries. These are found at the most innovative and quality oriented foundries in India. Automatic pouring allows foundries to eliminate armies of workers needed for dangerous work of manual pouring, increased casting production, higher casting quality and enhanced worker safety.

2. MAHINDRA HINODAY INDUSTRIES CASE HISTORY

Mahindra Hinoday Industries is a good example of Indian foundry benefiting from automatic pouring technology. Initially there was a limitation of 100 tons to the production and was the frequent need to stop the line waiting for iron. Much of this delay occurred because the metal in pouring ladle become too cold and production time was also lost in exchanging the pouring ladles, changing operators, etc. It is also experienced an average metal loss of 3 percent as a result of splashing and over pours during manual pouring. Overall casting yield was about 61 percent.

However within just six months of switching to automatic pouring industry have started routinely achieving production levels to 120 tons per day with overall increase in casting yield to 67 percent. The following benefits were obtained by implementing automatic pouring system :

1)Metal splashing and over pours while filling the mold were greatly reduced from 3% to less than 1%. 2) Casting defects are reduced considerably.3) Casting rejection is reduced to considerable amount.

As a result automatic pouring reduced the casting rejection rate due to operating safety margins for furnace overheating errors. This in turn resulted in longer refractory life. This is how Mahindra Hinoday got benefits.So to reduce the defects in Ashta Liners in the same way as that of Mahindra the ladle tilt type automatic pouring machine(APM) can be utilized.

The brief analysis and control of the system is explained further.

3. APM OVERVIEW

The typical APM in operation at foundries uses aservomotor-driven ladle as shown in fig.One of three servomotors is set on a vertically movingshaft, another on a horizontally moving shaft, and athird on the side of the ladle to tilt it. Rotary encoderson servomotors measure the ladle’s vertical and horizontalpositioning and the tilt angle. The weight of metal inthe ladle is measured by a load cell on the ladle support. The servo system receives signals from control equipmentsuch as sequencers that send commands for ladlepositioning and/or tilt, detailed below.

4. SYNCHRONOUS LADLE TILT AND POSITIONING CONTROL

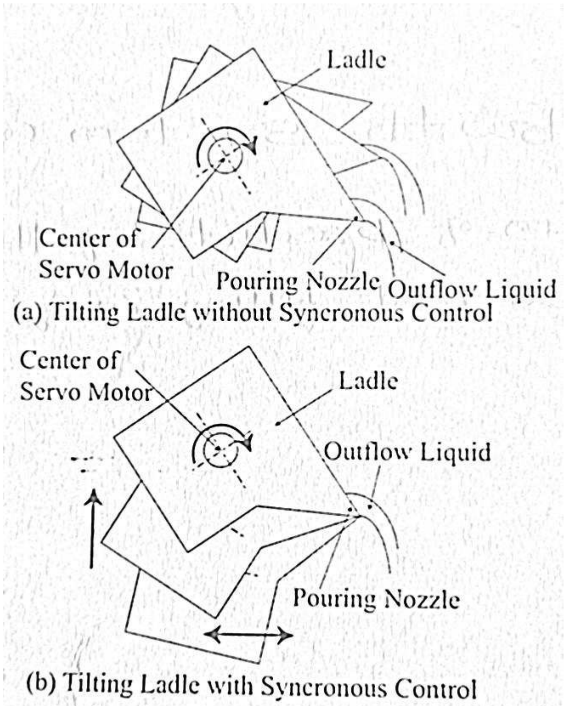

Fig1. Synchronous control for positioning pouring nozzle

As shown in Fig1 the motor for tilting the ladle is located near the ladle’s center of gravity. As a result, the position of the ladle’s pouring nozzle moves as the ladle is tilted by the rotation of the motor around the motor axle. By the movement of the pouring nozzle, the molten metal flow line cannot be steadied when it is poured into the mold. This makes pouring the molten metal into precise positions difficult. To solve this problem, when the ladleis tilted, it is also moved vertically and horizontally at the same time. By this synchronous control of the tilting and the positioning of the ladle, the location of the pouring nozzle is stayed at one point.

5. SLOSHING SUPRESSION CONTROL

Sloshing of molten metal in the ladle is caused duringthe pouring and ladle transfer. In order to suppress suchsloshing, the pouring and the transfer should be performedmore slowly. However, the slow motions lower the productivity.In addition, the temperature of the moltenmetal during the pouring lowers, then the inferior productswould be generated. Therefore, it is necessary tosuppress sloshing and complete quickly the pouring andtransfer. Such processes areput into practice through utilization of thevibration controltechnologies such as Notch Filter, Preshaping Method or Reference Governor Theories.

6. AUTOMATIC POURING CONTROL

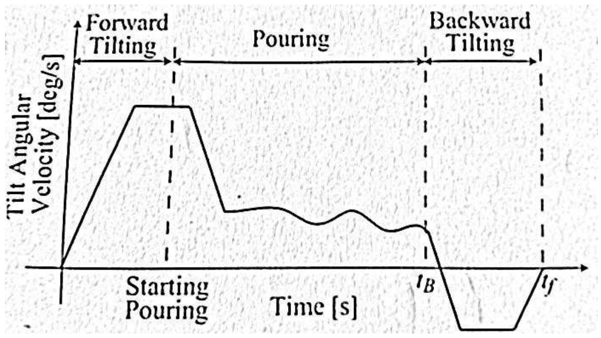

Fig2. Pouring control pattern

The pouring process in casting is controlled with tilt angular velocities as shown in fig2. As the process starts, the ladle is rapidly tilted forward until the molten metal begins to flow out of the pouring nozzle. Here, the flowing out of the molten metal is detected by cameras or laser-sensors.. During this process, the filling weight is measured continuously by load cell installed in the APM. In this paper, the filling weight means the weight of the molten metal filled into the mold. It equals to the weight of the molten metal poured from the ladle without splashing or spilling. On the last step in this process, the filling weight during the backward-tilting is predicted before the backward-tilting motion. Then ,when the sum of the predicted filling weight during the backward-tilting and the current filling weight measured by the load cell reaches the reference filling weight, the backward-tilting motion of the ladle will be started. , *tB*s denotes the time when the ladle begins to tilt

7. CONCLUSION

From above research we are concluding that in Zanvar Group of Industries manufacturer is suggested to implement the automatic pouring machine to reduce the defects and ultimately the rejections. Also this research is going to provide the input for pouring temperature, pouring rate ,and flow ability of SG200 for simulation software and also gives comparative study to improve the defects.

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