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Thermal Analysis of Tundish in Continuous Casting Machine in Steel Industry: A Review

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Abstract - ***The word tundish originates from a shallow wooden or metallic dish with an outlet channel, fitting into the bunghole of a tun or cask and forming a kind of funnel for filling it. These were originally used in brewing. The tundish is key element in the casting process, and it is act as reservoir for molten metal. This paper explores the different researches presented by researcher in order to study metal flow analysis of tundish and enhancement in the design and physical model also the presented research aiming to develop a new design of tundish with used of available study.***

Key Words: *Continuous Casting Tundish, Mathematical Modeling, Physical Modeling, Turbulent Fluid Flow.*

1. INTRODUCTION

In metal casting, a tundish is a broad, open container with one or more holes in the base. It is used to feed molten metal into a mold so as to avoid splashing and give a smoother flow. The tundish allows a reservoir of metal to feed the casting machine while ladles are switched, thus acting as a buffer of hot metal, as well as smoothing out flow, regulating metal feed to the molds and cleaning the metal. Metallic remains left inside a tundish are known as tundish skulls and need to be removed, typically by mechanical means (scraping, cutting). Scrap recovered in this way is ordinarily reused in the steelmaking process. A casting tundish is lined with refractory bricks specific to the liquid metal which is being cast.

Now days the casting process become more advance and advance with the work culture. In casting process the defects is most commonly observed. The casting defects like bubbling or cracking are often occurred. Many researches were presented or modifying the design of tundish. There exist various structure types of the tundish, the construction of tundish changes accordingly metallurgical demands and assumed level and grades of production. Now a days the priorities is given not only about the tundish construction type but also about other issues like the tundish capacity, the number and sections of molds, the casting instance, the length of casting sequence. This parameters are important for compare various construction types at the same capacity, and its required good knowledge of the "working zone" of the tundish, also the knowledge of molten metal hydrodynamics is required.

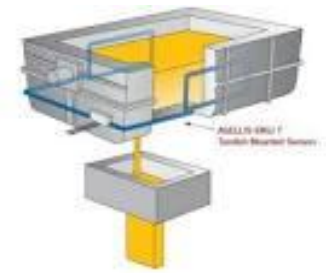

Fig.1.1-Typical Tundish Design

The working zone of the tundish is characterized by the following some constructive parameters like shape, dimensions and capacity, rather than this equipment of the working zone with flow control devices (FCD) is also very important. Such flow control devices include like dams, baffles, notches [2,3,4,6] or turbulence inhibitors [1,3,7] are used. Their role is to give appropriate direction to the flow of liquid steel in the tundish ,some researcher mainly concentrated on the numerical and physical modeling for proper low in the tundish [9][10][11].

The study of the flow and mixing way of fluid steel in the tundish in industrialized conditions is very complex, and the observation of the phenomena of interest impossible. To study the behavior of tundish liquid metal flow good way is available. This problem is easily studied by the modeling techniques. This research deals with study of tundish and its related or governing factors. Also in this research the different issues is put in study by different researcher.

2. LITERATURE REVIEW

A. Gaston et.al.[1] investigated on thermal analysis of tundish by finite element method. In this study the thermal analysis of molten steel filled tundish is carried

out by FEM techniques. The obtained results are validated with actual plant reading.

Kinnor Chattopadhyay et.al.[2] A review on fluid flow and turbulence, physical and mathematical modeling has been carried out on tundish. They have developed a physical model based on the study of steel making factory on basis of last decade's record and validated it with the mathematical model.

Miguel A. Barron et.al.[3] worked on the molten metal feeding control mechanism in continuous casting method. A differential model is developed in the study for regulating the flow of molten metal.

J. Pieprzyca et.al.[4] studied the effect of temperature fields on heterogeneity in the tundish on primary structure of continuously
cast ingots. The study mainly concentrated on the thermodynamics of molten liquid from its liquid states to crystallization all the parameters are observed and find the effect on ingot due metal overheating.

P. Gardin et.al.[5] investigated on An experimental and numerical study of turbulence in a tundish container using CFD.They have developed a experimental model of tundish by considering different parameters of molten metal, also developed the numerical model for validation using CFD domain.

S. K. Das et.al.[6] carried out the experimental study on the on turbulence improvement model of continuous casting tundish for slabs. In this the simulation model is developed for judging the flow of molten metal inside tundish. For this the three dimensional mathematical model was developed by using finite element analysis.

N. Drofelnik et.al.[7],carried out the worked for the interaction between steel melt and refractory materials of tundish. They have study the various factors affected the tundish, like clogging and slugging of molten metal. This clogging and tundish slag occurred in the tundish is optimized by different techniques was studied.

T. Kargul et.al.[8],carried the investigation the thermal analysis of continues casting. In this study the numerical model is developed on the basis of results obtained. The results of this research show thermo physical properties which are necessary to carry out numerical simulation of continuous casting of steel.
Brian G. Thomas et.al.[9] presented mathematical modeling of fluid flow in continues casting method. The nature of low inside the tundish was studied in the and also various effect of heat transfer, electromagnetic forces, interfacial phenomena and interactions between the steel surface and the slag layers, the transport of solute elements and segregation is studied.

R.Pardesi et.al.[10] carried out the work on the Mathematical Modeling of the Single-Strand Slab Caster in the Tundish. The variation of tundish temperature under the influence of various operating parameters is numerically simulated using a mathematical model, this research study the parameters affecting outlet temperature of tundish.

Yogeshwar Sahay et.al.[11] carried out the work on the metal flow characterization in tundish continuous casting process.In this a model was developed the fluid volume in tundish is considered to be consisting of the plug flow, well-mixed flow, and dead volumes. This presented a correct model for future study.

Dr.T.R.Vijayaram [12] studied on the continuous casting metallurgy technology. This research discussed on the continuous casting process description, mechanism, control, hydrodynamics, heat transport, thermal analysis, heat transfer, continuous cast product types, solidification control and range of sections, and also advantages of continuous casting technology for ferrous and nonferrous foundries.

K. Michalek et.al. [13] Carried out works on the model study of tundish for judging the intermixing and operational verification. In this the numerical model was developed for study the flow of tundish and carried out the CFD using ANSYS fluent tool.

R. D. Morals et.al. [14] Investigated works on the numerical and steel modeling analysis of liquid flow in the tundish with different flow control devices. In this the three different cases were consider for flow control of liquid flow, the inhibitor and a pair of baffles control devices shows good performances on water flow model.

A. Cwudzinski et.al. [15] carried out works for numerical analysis of liquid steel, with one strand slab tundish and sub flux turbulence controller in dam tundish. The different parameters were recorded with different flow control devices.

Zhu He et.al. [16] Investigated on the flow control devices in tundish with metal liquid. In this study inhibitor and a pair of baffles alternatively used for controlling the flow. The turbulence inhibitor shows good controlling in tundish for metal flow.

L. Sowa et.al.[17] carried out the works on the continuous metal flow casting slab. They have developed a numerical simulation model in the tundish. This problem is treated by using finite element method.

T. Merder [18], carried out the numerical simulation of liquid flow and mixing steel in multi-strands tundish. This

experiment is carried out for optimizing the design of tundish.

Dipak Mazumdar et.al. [19] Presented the review on the basis of physical and mathematical modeling in continuous casting operation within tundish .In this research they have categorized the tundish operation on basis of mathematical and physical modeling.

A. Cwudzinski [20], presented work for obtaining the hydrodynamic nature of fluid flow within tundish .The numerical and computational model is developed or carried out this study. The obtained results were employed in computer simulation.

3. PRAPOSED PLAN WORK

Many researcher has been addressed the different techniques for improvement in the flow in tundish. Tundish geometries are design and developed on the basis of numerical and computational modeling. The improvement in flow of tundish is an important in continuous casting process, and for overcoming the turbulence. The physical modeling is proposed to develop on the basis of available data. The physical design and geometries is proposed to optimize in respect to improvement in flow of molten metal. The Computational fluid analysis is also proposed to carry out with optimize design and different flow control devices. Finally the obtained results are validated with the numerical modeling and comparison is made between existing design and new proposed design on the basis of different parameters.

3. CONCLUSION

This research discussed about the different literature based on the physical and numerical modeling of tundish. The different researches are widely investigated both analytically and experimentally by different researchers. A number of studies have been agreed in order to study the effect of various parameters and design of tundish in continuous flow casting process.

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