Study of an innovative ladle shroud to decrease slag carry over due to vortex formation

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ABSTRACT

This work seeks to investigate how to prevent some teeming phenomena appearing during late-stage steelmaking. More precisely the appearance of vortices within the ladle, which has been shown to increase the amount of slag carry-over to the tundish. This, in turn, compromises the quality and reduces the yield from each teeming. The present phenomena are observed by applying a rotation to water within a vessel, which is then teemed through an outlet located in the bottom of the vessel. Limitations were made based on other attempts to reduce the formation of vortices by installing different units above and around the outlet in the ladle. The solutions have been shown to clog up after repetitive use. Therefore emphasis was put on the ladle shroud, which is replaced after each sequence of casting. Prototypes were developed in Solid Edge and produced with a 3D printer. These prototypes were then installed in the outlet of the vessel and the effects on the teeming processes and vortices were studied. It was found that it is possible to suppress the rotational velocity close to the outlet and thereby have the effect transfer up into the vessel and limit the vortices to reach the outlet. Theoretically this will limit the top slag to carry-over from the ladle to the tundish. Assuming the effect would be the same in full-scale production, if implemented, it could provide economic and environmental benefits. This in terms of better productivity and less energy consumption. This because the mills won't have to circulate as large amounts of steel.

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