

Heat Loss Reduction Technologies for Torpedo Ladle Car

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Extended Abstract

Steel making companies are being demanded to reduce the CO₂ production. To meet this demand, most companies are using more scraps, which means less production of hot iron in the blast furnace. But using more scraps in the steel making process requires more heating materials such as Fe-Si to compensate the lack of the energy during refining process. This increases the manufacturing cost for the molten steel, and it is another issue for the steel making companies.

In this study, we will present how the heat loss can be reduced at the torpedo ladle car which transports the hot iron from the iron making plant (blast furnace) to the steel making plant (converter) to reduce the use of heating materials in the steel making plant.

We analysed how amount of heat is dissipated from the opening and the steel surface with numerical simulation. The results showed a third of the heat dissipation from the opening and the others from the steel surface.

Firstly, we designed and made the insulating cover at the top opening area, which is operated to open and close with remote controller at the specific areas. The rechargeable battery is used to supply the power to move the cover. This cover acts as the radiation shield between the atmosphere and the hot iron in the torpedo ladle car and shows the good insulating performance.

Two thirds of the heat loss happens through the steel surface, which temperature is around 350°C. We tested different types of insulators at the outside and the inside of the surface, respectively. Between the steel surface and the inner refractories (working and safety blocks), we adopted the insulating board which the thermal conductivity is about 0.1 W/m²K. This insulating material is also required for the enough compression strength, considering the pour of the hot iron from the blast furnace.

We also tested the insulating paints at the outside of the torpedo ladle car, which thermal conductivity is about 0.03 W/m²K and can be used up to 1,000 °C. This paint consists of the micro-sized Si aerogel which contains the air and the binder which resists against the high temperature. These kinds of Si aerogel insulation systems were used in space launch applications and are spread to the other engineering applications [1]. This can be also applied to the inside of the steel surface.

After constructing above three structures at each torpedo ladle cars, we checked the temperature of the molten iron in the torpedo ladle cars at every hour for 4 hours and compared the heat insulation performance. The performance of the inside and outside insulating materials are similar and above the insulating cover.

With these results, we are tackling the other ladle to reduce the heat loss of the molten steel which is produced at the steel making plant and transferred to the continuous caster. This result can be presented at the conference.

References

- [1] L. Zhang, L. Zhu, C. Zhang, Z. Wang, P. Xiao, Z. Liu, "Physical Experiment and Numerical Simulation on Thermal Effect of Aerogel Material for Steel Ladle Insulation Layer," *Coatings*, vol. 11, pp. 1205, 2021.