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ISSN 0543-5846
METABK 57(3) 146-148 (2018)
UDC – UDK 621.746.536.24:662.998:621.776:536.5=111

STUDY ON INSULATION EFFECT OF HOLLOW RISER

Received – Primljeno: 2017-11-28
Accepted – Prihvaćeno: 2018-03-30
Original Scientific Paper – Izvorni znanstveni rad

According to the air insulation, the use of riser hollow way to reduce the riser heat transfer, improve the riser insulation effect. In the experimental simulation, the corundum brick inner and outer wall and the air gap temperature were measured. The optimal air gap is 25 mm from the heat transfer theory and the outer wall temperature, but the insulation effect is not obvious. To further explore, proposed in the inner and outer walls to 25 mm as a unit into the insulation board improvement measures. The results show that the insertion of the insulation board can greatly reduce the temperature of the outer wall and improve the insulation effect. When inserting a heat shield, the heat flow can be reduced by about 50 %. With the increase in the number of inserts inserted, the insulation effect is gradually increased.

Keywords: casting;heat transfer;hollow;insulation;temperature

INTRODUCTION

Casting production, due to casting solidification shrinkage, often a variety of quality problems. Casting production, due to casting solidification shrinkage, often a variety of quality problems. In order to improve the quality of castings, often set up riser to improve the compactness of the casting [1, 2]. Common riser capacity is limited, especially for large castings, riser metal liquid accounted for about half of the castings, to follow-up cutting riser, remelting metal to bring a huge workload. To this end, it is proposed to extend the time of solidification of the molten metal in the riser, thereby reducing the size of the riser. In order to improve the riser insulation performance, there have been insulation riser, fever riser and other technologies [1].

In this paper, according to the current production situation of large castings and air insulation, it is proposed to use air gap riser technology to establish the air gap riser insulation model [3, 4], tudy the different air gap under the riser insulation effect. In order to further improve the insulation effect of the air gap, it is proposed to insert the insulation plate in the air gap, and to test the insulation performance and influence parameters of the hollow riser through the design experiment.

EXPERIMENTAL DESIGN AND METHOD

The temperature measurement of the air gap riser experiment was carried out. Five groups of data were planned to be 0, 5, 10, 25 and 40 mm respectively. According to the air gap device shown in Figure 1, two corundum bricks were placed. In the high temperature resistance furnace position, insert three thermocouples (to ensure the accuracy of the experiment, all the temperature points on the same horizontal line), and with asbestos felt to seal. Start the resistance furnace, the resistance furnace temperature set at 1 100 °C, every 5 min record the temperature of three thermocouples (shows the temperature of two corundum brick and two corundum brick air gap between the temperature) and resistance furnace Temperature (shown on the resistance furnace temperature controller). When the resistance furnace temperature rises to the set temperature, and again to verify the set temperature of 1 100 °C, the resistance furnace temperature controller will automatically adjust the temperature stability in the vicinity of 1~100 °C (10 °C or less), continue to record the temperature, When the thermocouple temperature changes in the stability of 1 ~ 2 °C, and even temperature stability for a period of time no longer change, will stop recording, completed a group of hollow air gap measurement, the whole process with about 7 h. Resistance furnace and simulation device cooling (the experiment using natural cooling method) to room temperature, change the air gap distance, repeat the above experiment for the next group of air gap temperature measurement.

ANALYSIS OF INSULATION EFFECT OF AIR GAP

In order to analyze the air gap and the different air gap under the insulation effect, the temperature measured by the experiment curve (Figure 2). It can be seen that as the heating process progresses, the wall temperature rises rapidly and then slowly rises to equilibrium. When close to steady state, the inner wall temperature curve is basically coincident, which conforms to the inner wall heat transfer law of the same resistance furnace. When the experiment reaches steady state, the outer wall temperature is not the same. So the outer wall temperature can be used

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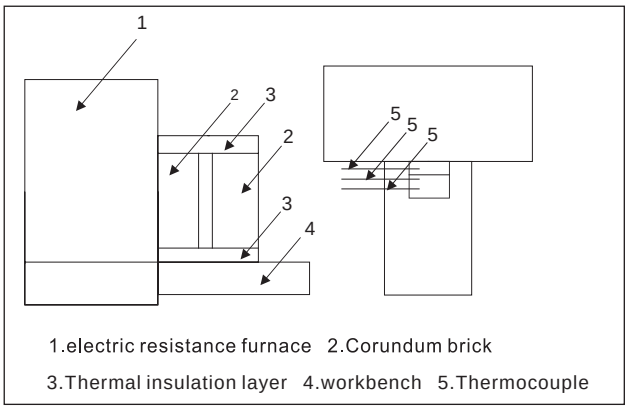

Figure 1 The experiment apparatus

to determine the insulation effect. The outer wall temperature reached the highest in the absence of air gap, while the 25 mm air gap when the outer wall temperature is the lowest, which initially concluded that the air gap is 25 mm when the insulation effect is better.

When the experiment reaches steady state, the heat transfer theory of heat transfer between the two corundum brick and air gap at the same heat transfer. Using the heat transfer formula [5] to calculate the heat transfer of the first corundum brick at steady state.

$$q = \lambda \frac{\Delta t}{\Delta x} \tag{1}$$

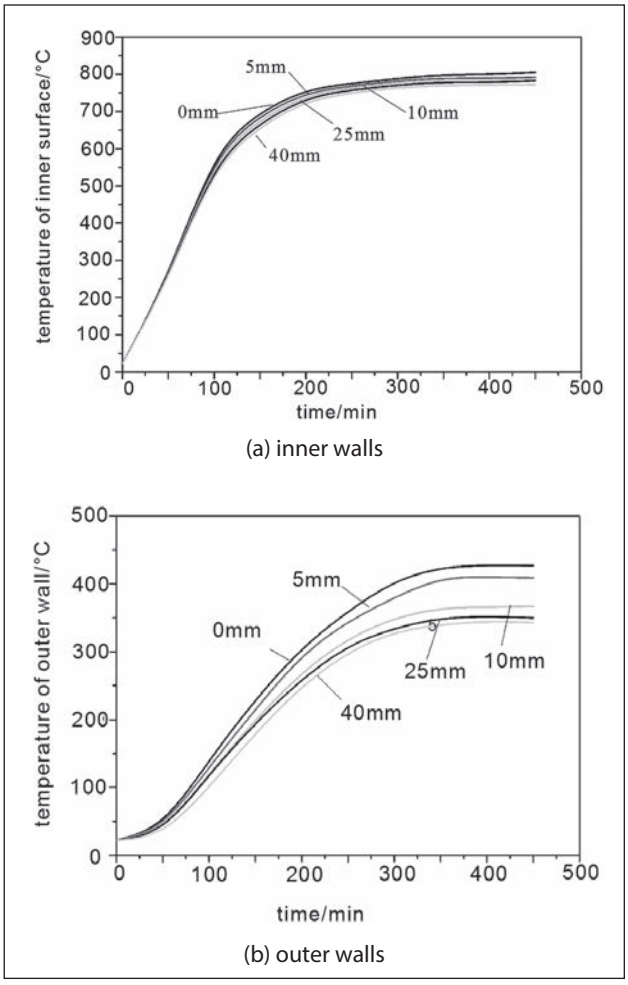

Figure 2 The temperature carves of inner walls (a) and outer walls (b)

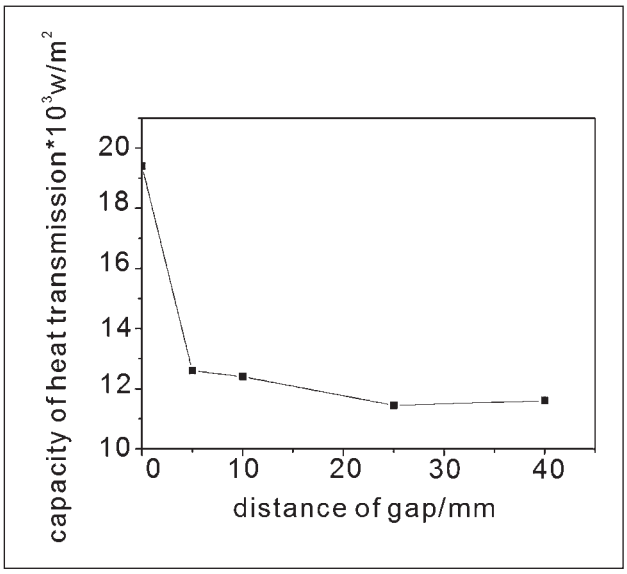

Figure 3 The capacity of heat transmission with different air gap

Where q is the heat flux, W / m^2; λ is the thermal conductivity, W / (m • °C); Δt is the temperature difference between the inside and outside wall of the corundum brick, Δx is the thickness of the corundum brick, mm.

According to the experimental conditions, λ is 3,3 W • (m • ° C) $^{-1}$. Since the temperature of the surface is difficult to be determined by the experiment, the temperature of the inner wall is approximated by the temperature of the inner wall. The temperature of the air gap is approximately the outer surface temperature. 65 mm. Through the calculation, no air gap and different air gap under the first corundum brick heat transfer as shown in Figure 3. It can be seen that when there is no air gap, the heat transfer is very large, reaching 19 444,62 W/m^2; when there is air gap, heat transfer is significantly reduced. It can be seen, because the air has a good thermal insulation, the use of hollow air gap technology can reduce the heat transfer, improve the insulation effect. As the air gap increases, the heat transfer decreases in turn, but decreases slowly. Where the air gap is 25 mm, the heat transfer reaches a minimum of 11 169,23 W/m^2; when the air gap increases to 40 mm, the heat transfer increases. The reason is that when the air gap thickness is large, the air flow inside the air gap increases, the effect of thermal convection increases, resulting in increased heat flow, insulation effect decreased.

ANALYSIS OF INSULATION EFFECT OF INSERT INSULATION BOARD

In order to further explore the effect of insulation, it is proposed to insert the insulation plate at the best air gap distance, use the heat shield to reduce the heat transfer in the air gap and suppress the thermal convection in the air gap to further improve the insulation effect.

In this experiment, 50 mm hollow air gap was inserted into one insulation board, 75 mm hollow air gap

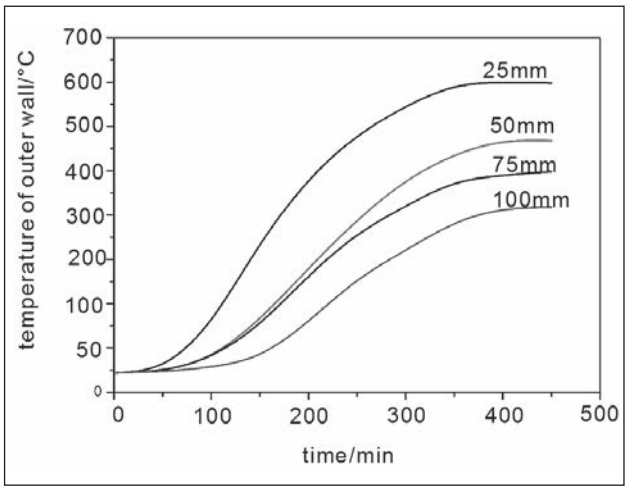

Figure 4 The temperature carves of outer walls

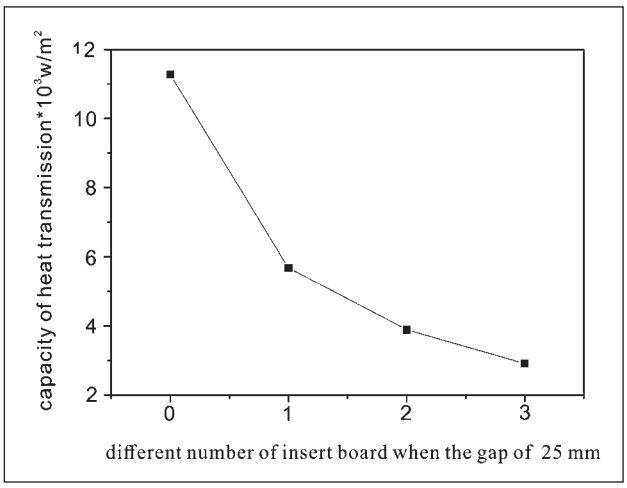

Figure 5 The capacity of heat transmission with the air gap of 25mm and different number of insulation board

was inserted into two heat insulation plates, 100 mm hollow air gap was inserted into three heat insulation plates. Figure 4 for the experiment to achieve steady state, the outer wall temperature curve. It can be seen that the insertion of the heat shield can significantly reduce the outer wall temperature. With the increase in the number of inserted partitions, the lower the outer wall temperature, the better the insulation effect. The reason is that the main heat transfer in the air gap is heat radiation, when inserted into the insulation board can effectively reduce the radiation heat, thereby improving the insulation effect.

When the experiment arrives at steady state, the heat flow calculation result is shown in Figure 5, when inserting a heat shield, the heat transfer is about 50 % of the best air gap heat transfer, insert the two insulation board, the heat transfer is about 33 % of the best air gap, insert the three insulation board , heat transfer reduced to 25 % of the best air gap. The calculation results show that with the increase of the number of flapper, the heat transfer capacity is greatly reduced and the heat preservation effect is further improved. But with the increase in the number of cards, heat transfer reduction has decreased, according to the actual situation to select the corresponding number of cards.

CONCLUSION

(1) The experimental results show that the addition of hollow air gap between the inner and outer walls can reduce the temperature of the outer wall and improve the insulation effect. However, after the air gap thickness is increased, the thermal insulation effect is improved due to the increase of the thermal convection of the air, so the insulation effect is best when the air gap thickness is 25 mm.

(2) In order to further improve the insulation effect, the insulating plate was inserted between the hollow air gap. The experimental results showed that the heat flow was reduced by about 50 % when the heat transfer was interrupted. The more the number of plates, the smaller the heat flow when the heat balance, the better the insulation effect, can be considered in terms of insulation requirements, production costs and other factors to determine the number of cards.

(3) The use of air gap insulation technology, will be applied to the riser design, can increase the riser thermal resistance, reduce the riser heat transfer, significantly improve the riser insulation effect, delay the molten steel in the riser solidification time, So that the volume of the riser greatly reduced, bringing significant benefits.

Acknowledgements

This work has been supported by Joint Fund of State Key Laboratory of University of Science and Technology Liaoning-Sea Industrial Steel Group.

This article is funded by the China Liaoning Natural Science Foundation (201602386)

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Note: The responsible translator for English is Z.Q. Lv, University of Science and Technology Liaoning, Anshan, Chi