Direct observation and simulation of ladle pouring behavior in die casting sleeve

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ABSTRACT

The ladle pouring process is one part of die-casting which has the advantages of high speed, good quality and mass production. The molten metal is quickly poured into the sleeve by tilting the ladle, and immediately injected into the die cavity with high speed and high pressure by advancing the plunger. Since the entrapment of air and the generation of solidified layer in the ladle pouring may cause the defects of cast products, it is necessary to simulate the ladle pouring behavior.[1]

In the present study, the pouring experiment into the rectangular container 300×60×35mm (hereinafter called sleeve) using water and die-casting aluminum alloy JIS-ADC12 are carried out to observe the flow bahaivior by tilting the ladle. The temperature of molten metal is measured using thermocouple in order to investigate the heat transfer behavior. The conditions of three tilting speed and three angle between ladle and sleeve are investigated. Further, the flow behaviors in ladle pouring of water and molten aluminum alloy are simulated using Particleworks^{TM} of MPS software.[2]

The simulation results, when using water are almost the same actual wave behavior. It is difficult to simulate the wave behavior of molten aluminum alloy cause there is a difference in wave behavior between water and molten aluminum alloy.[3] The temperature of molten aluminum alloy estimated by the simulation also does not corresporded to the measured value.

On the other hands, it is clear that the molten aluminum alloy is not solidified during wave behavior in the early stage of pouring by the experiments. These results obtained by the experiments show the same tendency even if the tilting speed is changed or the angle between ladle and sleeve changed.

Therefore, we try to adjust the kinematic viscosity of molten metal and the thermal conductivity of sleeve die. As the result, the wave behavior and temperature of molten aluminum alloy after adjusting the parameters are almost agreed with the actual phenomena. Flow and heat transfer simulation using the MPS method is effective method that ladle pouring of molten aluminum alloy with free surface flow can be simulated accurately.

In this research, although tuning the physical values to match the actual phenomena, this method is not theoretical one.It is considered necessary to introduce the model expressing the features of molten aluminum alloy in the future.

REFERENCES

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