Simulation model of casting processes and its applications by Smoothed Particle Hydrodynamics method

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ABSTRACT

Metal casting is a production process in which molten metal is poured into a mold and solidified to obtain a product having a desired shape and property. In computer-aided engineering (CAE) of the casting processes, in order to predict casting defects and to design a casting plan, it is necessary to simulate the flow behavior including free boundary and moving boundary, the heat transfer phenomena, and solidification phenomena adequately. Because of the mesh-less characteristics, there is an expectation that the particle-based methods are applicable to casting processes for which grid-based algorithms are not suitable.

In the casting processes, casting defects, e.g., shrinkage cavities, blowholes, porosity defects and so on, often occur and become problems. In order to apply the particle-based simulation to casting field, it is important to predict such defects. We develop numerical methods to treat physical phenomena which affect the casting defects, based on a smoothed particle hydrodynamics (SPH) method[1] in which solidification and shrinkage of molten metal are represented. Since air entrainment of molten metal, e.g., shown in Fig. 1, can cause porosity defects, we explore a method to detect generation of air bubbles and trace them. In order to collapse shrinkage cavity, pressurization to molten metal is sometimes used. We also develop model to pressurize fluid in mold. This model can be utilized to squeeze casting. Fig. 2 is an example of collapse of shrinkage cavity by pressurization.

We will report the comparative study result of numerical simulation and actual casting experiments as well as the numerical methods we have developed.

Fig. 1. An exsample of air entrainment

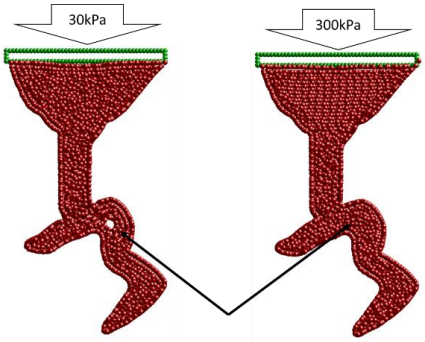

Fig. 2. An example of collapse of shrinkage cavity by pressurization.

REFERENCES

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