Applications of Distinct Element Method to the numerical simulation of sand molding

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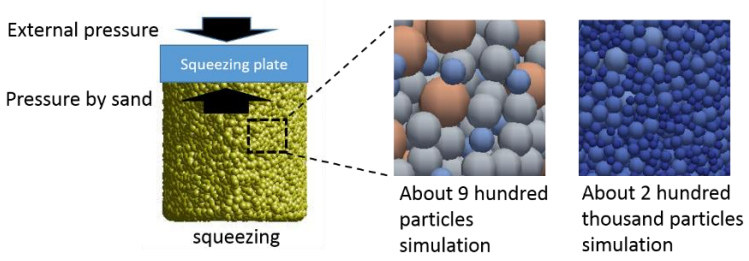
ABSTRACT

In the casting process, molten metal is poured into the mold and then solidified by cooling. As a result, we are able to get complex shaped metal products. The quality of the mold is one of the important factors for quality of resultant casting product. The molds called sand mold, which are widely used in the cast iron casting because of their inexpensiveness and high heat resistance compared to metal die, are manufactured by molding sands in order to obtain sufficient strength not to collapse when molten metal is poured. In addition, by the squeezing compacting, we are able to obtain the sand mold with high strength and uniform granularity. Therefore, in order to manufacture high quality sand mold, it is important to clarify the behaviour of sands in the squeezing process. Numerical simulation of squeezing process using Distinct Element Method (DEM) are expected to be a powerful tool for optimizing the molding conditions.

In the previous studies of the numerical simulation of squeeze molding process [1], they demonstrated that pressure of the sand when compacting on the squeezing plate can be represented by the DEM simulation, despite the diameter of DEM element is larger than that of actual sand. However, recent result [2] reported that the pressure on the squeezing plate obtained by DEM is affected by the initial condition of the particle size distribution. This result suggests that we need to research the effect of the diameter of DEM element more detail. Additionally, these simulations of squeezing were performed by using only the simple cylindrical shape, although actual sand molds often have complex shape.

In this study, we calculate the same process of [2] with smaller element size. We have parallelized the numerical method of [2] to deal with the increase in computational cost associated with decreasing particle size. And we investigate the dependency of the simulation results on element size. Moreover, in order to calculate squeezing process with complex shape, we introduce the representation method of shape using signed distance function [3] [4]. We will show some numerical results of our method.



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