Numerical simulations of molten aluminum alloy pouring and its calculation speed up by EISPH

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ABSTRACT

In the casting process, the molten metal is poured to a mold and solidified by cooling so as to obtain a metal product of the desired shape. In this process, it is important to clarify the flow process of the molten metal, in order to predict the defects of the metal products. The direct observations of the flow of the molten metal in a mold are difficult, thus the numerical simulations are useful for this purpose. Because of the mesh-less characteristics, particle-based methods, such as the smoothed particle hydrodynamics (SPH) method, are suitable for the treatment of the free surface of the molten metal, which should be simulated in the casting simulation.

On the other hand, it is well known that the fluid behavior of molten aluminum alloy is very different from that of water, due to the generation of oxide film (Fig.1). Therefore they have developed the numerical model of the effect of the oxide film [1]. However, in previous research, numerical results which use the oxide film model are validated for only a few cases of pouring condition, in which molten aluminum alloy is poured along the runner.

In this research, we apply the numerical model to many cases of pouring condition of molten aluminum alloy. In some of the conditions, flow of molten aluminum alloy shows a characteristic behavior of meandering when poured at an angle. We also compared the results with the experimental results. Moreover, in order to reduce the calculation cost, we also perform these pouring simulations by EISPH [2]. We will show some numerical results and experimental results, and also show speed up effect by EISPH.

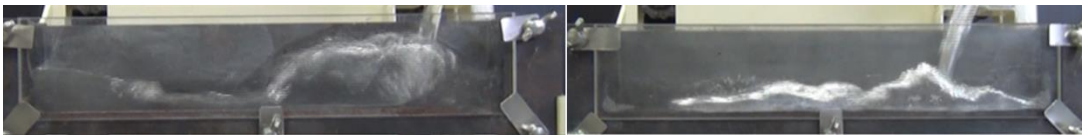

Fig.1 pouring experiment with water (left) and molten aluminum alloy (right).

Fig.2 Experiment of aluminum alloy and simulation with EISPH.

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