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Effects of liquid-phase viscosity, gas phase fraction, and sedimentation particle density on foam bubble structure and particle sedimentation behavior

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In a converter process, foaming slag has advantages in that it facilitates intermediate deslagging and protects refractory materials in the furnace. On the other hand, in an electric arc furnace process, foaming slag improves the arc heat transfer efficiency by acting as an insulator. In both steelmaking processes, slag foaming is important. In the slag, there are suspended particles of iron that are caused when gases blown into the molten iron lift the liquid iron phase into the slag phase, and the maximum size of the particles is about 2 mm. After the refining and smelting process is completed, the slag is discharged from the furnace after the steel is tapped. If the particle iron is not sufficiently settled at this time, the particle iron present in the slag will become iron loss as it is. Therefore, the sedimentation behavior of particles in forming slag, which is a gas-liquid multiphase fluid, is an important issue, however, the sedimentation behavior in this fluid is obviously different from that of particles in the homogeneous liquid phase. In this study, falling-ball experiments were conducted at room temperature to investigate the sedimentation behavior of particles in a gas-liquid multiphase fluid by varying the single liquid phase viscosity, gas phase fraction, and sedimentation particle density. From the results, apparent viscosity was determined using the Stokes' law. While, viscosity of the single liquid phase affected a bubble-filling structure of the gas-liquid multiphase fluid, and each sedimentation particle with different density exhibited dissimilar sedimentation behavior.

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