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Computational Fluid Dynamics Simulation on Heat Transfer of Hot Air Bubble Injection into Water Column

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Abstract : When air flow is injected into water, bubbles are formed in various types inside the water pool along with the air flow rate. The bubbles are floated in equilibrium with forces such as buoyancy, surface tension and shear force. Single bubble generated at low flow rate maintains shape, but bubbles with high flow rate break up to make mixing and turbulence. In addition to this phenomenon, as the hot air bubbles are injected into the water, heat affects the interface of phases. Therefore, the main scope of the present work reveals how to proceed heat transfer between water and hot air bubbles injected into water. In the present study, a series of CFD simulation for the heat transfer of hot bubbles injected through a nozzle near the bottom in a cylindrical water column are performed using a commercial CFD software, STAR-CCM+. The governing equations for incompressible and viscous flow are the continuous and the RaNS (Reynolds- averaged Navier-Stokes) equations and discretized by the FVM (Finite Volume Method) manner. For solving multi-phase flow, the Eulerian multiphase model is employed and the interface is defined by VOF (Volume-of-Fluid) technique. As a turbulence model, the SST k-w model considering the buoyancy effects is introduced. For spatial differencing the 3th-order MUSCL scheme is adopted and the 2nd-order implicit scheme for time integration. As the results, the dynamic behavior of the rising hot bubbles with the flow rate injected and regarding heat transfer mechanism are discussed based on the simulation results.

Keywords : heat transfer, hot bubble injection, eulerian multiphase model, flow rate, CFD (Computational Fluid Dynamics)
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