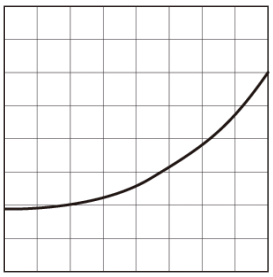
Free Surface Flow Analysis of Airlift Pump

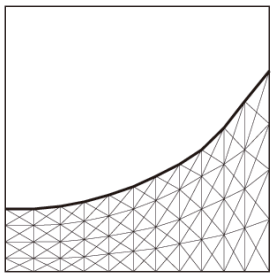
Free surface flow analysis of an airlift pump using MARS method of scSTREAM

Free Surface Flow Analysis



Interface Capturing Method

Simulates interface behavior by using advection of a function that represents the interface: MAC (Marker And Cell), Level Set, VOF (Volume Of Fluid), MARS methods.



Interface Tracking Method

Simulates the interface behavior by deforming the elements representing the interface: ALE (Arbitrary Lagrangian and Eulerian).

Free Surface Flow Analysis of an Airlift Pump

Free surface flow analysis is performed for an airlift pump, which is used for pumping of well water, hot spring, and clear well, with an interface capturing method, MARS (Multi-interface Advection and Reconstruction Solver) method.

Mechanism of Airlift Pump

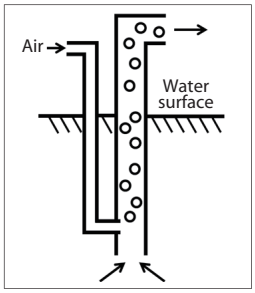


Figure 1: Airlift pump

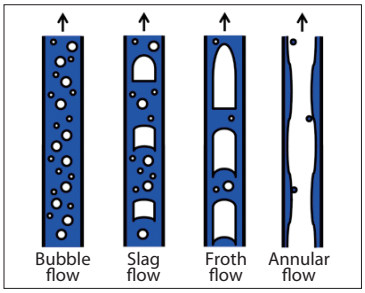


Figure 2: Types of two-phase flow

- Air is flowed into a (lifting) pipe placed under water as shown in Figure 1. Water inside the pipe is mixed with the air, becomes less dense, and is lifted upward.
- The amount of lifting is determined by an empirical formula based on the amount of the delivered air, the submergence depth, and the pump head height. Depending on the objectives, aeration may or may not be facilitated. The type of two-phase flow inside the pipe (Figure 2) needs to be understood.
- Visualization in experiment may not be possible for various reasons. Flow simulation can be effective in understanding the type of flow.

Analysis Model

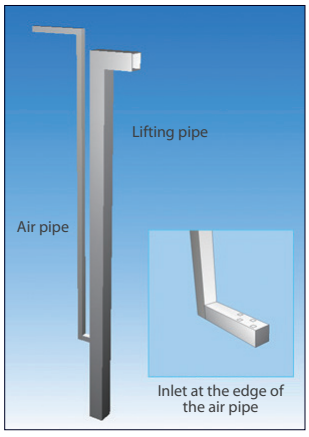


Figure 3: Pump analyzed

Lifting pipe	5 cm square
Air pipe	2 cm square
Inlets	4 houndstooth arrangement
Air flow rate	25 [L/min] every 0.1 [s] per inlet

Pump is placed 1 [m] underwater and water is pumped to the reservoir 10 cm above water surface.

Analysis Results

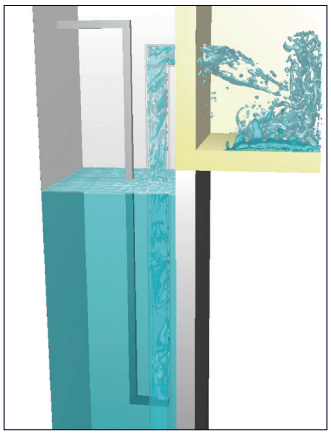


Figure 4: Isosurface

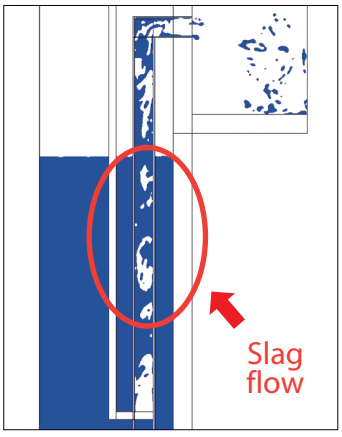


Figure 5: Gas-liquid distribution

Notes

Gas-liquid interface is visualized with an isosurface (Figure 4). The analysis result simulates well how the water mixed with air is lifted and poured and splashes into the reservoir. Figure 5 shows gas-liquid distribution on the middle cross-section of the pipe. Water is shown in blue. From this figure, the type of flow inside the pipe can be predicted as a slag flow.