CFD STUDY ON FLOW THROUGH SINGLE-HOLED ORIFICE PLATES IN SERIES

Akash S.[1], Gowsihan N.[1], Hrithik C.[1], Dr. Naren P.R.[2]

[1] Chemical Engineering 2018-2022, School of Chemical and Biotechnology (SCBT), SASTRA University;

[2] Associate Professor, School of Chemical and Biotechnology (SCBT), SASTRA University

Abstract

Orifice meter is used to measure flow rate, induce local mixing, and can also cause hydrodynamic cavitation. This work focuses on numerical estimation of pressure profile across flow through orifice meters and hence to understand the effect of orifice configuration on pressure profiles obtained. As part of the work, existing experimental data and CFD simulations of flow through orifice have been documented and were used to arrive at the base case geometry. A circular cross-section pipe of 2-inch diameter with a single-hole orifice of beta 0.5 was taken as the base system. The upstream and downstream lengths were fixed as 20D, where D is pipe diameter. A steady-state 3D RANS model was developed and simulated for typical flow conditions in ANSYS (Version 2021 R1). Initially, grid sensitivity analysis was performed on flow through single-hole orifice. Simulations were performed to obtain pressure profile across the orifice and thereby compute discharge coefficient over a range of Reynolds numbers. Transient simulations were performed with same conditions to show that steady state simulation was acceptable. Comparisons were made between the simulated data and reported correlation for flow through single orifice. Data obtained from simulation of single holed orifice was used to create geometries for multiple plate single-holed orifice in series. Flow through multiple plate single-holed orifices with varying pitch distances were simulated and to ascertain the effect of pitch distance and Reynolds number on the pressure profiles obtained. The data was analyzed to ascertain if cavitation was feasible for the geometries considered.

Keywords: Orifice meter, CFD, ANSYS, Multiple plates, Pressure drop, Discharge Coefficient