Numerical study of the characteristics of supercavitation on a cone in a stationary evaporator

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ABSTRACT

Computation results of the supercavitation on a cone in a bounded axial cold water (20˚C) flow, obtained by ANSYS13 CFX and FLUENT, are found to correlate with experimental data. CFX solution has captured considerable backflow, and temperature gradient of 7˚C between free water stream and steam inside the supercavity, with the average water vapor temperature of supercavity volume equal to 17.8˚C, while FLUENT has revealed negligible temperature gradient, and the position of backflow vortex is different. Although we have used the same setup and appropriate meshes for both solvers, due to different cavitation models: mixture Rayleigh–Plesset and Schnerr-Sauer, for CFX and FLUENT, respectively, we have found wide discrepancy in the resulted thermal, mass, and velocity flow fields. Understanding thermal, mass, and velocity fields of the supercavitating flow is important for the development of an industrial application of supercavitation for the design of the evaporators, open-type heat exchangers, coolers, deaerators, mixers, and chemical reactors. The CFX solver have been used for revealing the multiply factor response of the supercavitating flow on the temperature of source water, its inlet velocity, rate of steam extraction from the supercavity, and the degree of flow obstruction by the cavitator. This analysis goes beyond the presently referred experimental results, and the influences of the each factor on the supercavitating flow dynamics have been formulated in respect of the steam volume fraction, steam motion and effective temperature influence on the interphase heat mass transfer.

Keywords: Thermal desalination; CFX; FLUENT; Cavitation; Thermal energy model; Bounded flow

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