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A two-dimensional numerical study on the development of two-phase flow inside a vertical solar collector pipe imposed by a homogeneous heat flux

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Direct solar heating systems have become a renewable energy solution for manufacturing processes. However, research on the use of parabolic trough reflectors in producing distilled water is relatively rare. In such investigations, in general, the receiver tube mounted in the focal line of the parabolic trough absorbs the concentrated solar irradiance and transfers the absorbed energy to the heat transfer liquid without a phase change. In this study, the flow distribution inside a two-dimensional pipe (receiver tube) was studied as a time dependent two-phase flow problem as a test case for the real experimental three-dimensional solar collector system. The evaporation and condensation phenomenon of the process was modeled using the volume of fluid method together with the energy equation as used in many researches for two-phase problems. The simulation was carried out in a rectangular domain with an open outlet which is typically used in water heating systems. The intended boundary value problem considered vertical adiabatic walls and heat flux with an imposed linear intensity of 15 kW/m as the typical concentrated solar irradiation is around 55 kW/m^2. The implementation was performed using ANSYS Fluent 14.0 software. Under these conditions, the bubble generation and evaporation were observed after 9 s which was in agreement with the experimental process. The corresponding volume fractions and velocity profile are visualized in the simulation. The results had a good agreement with the evaporation and condensation processes obtained so far by the other researchers. The experimental setup for this scenario has already been developed. Thus, the simulation approach needs to be further improved by identifying the actual heat flux and validated by experimentally measured data.

Key words: *Solar collector pipe, parabolic trough reflector, two-phase flow, volume of fluid method*

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