عنوان مقاله:

Thermal Behavior of Laminar Flow of Supercritical CO۲ in a Long Vertical Mini-Pipe under Constant and Stepped Wall Heat Flux

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خلاصه مقاله:

In this study, the convective heat transfer of supercritical carbon dioxide in a long vertical mini-pipe has been investigated numerically. The numerical solution has been performed with the finite volume method and by developing a CFD code. The pipe has a length of ۵.۵ m and a diameter of ۱ mm which is exposed to a constant heat flux at the wall with values of ۳۰۰, ۴۰۰, ۵۰۰, and ۶۰۰ W/m۲ or step changes. In addition to the wall heat flux, the effects of gravity and flow direction have also been examined. Furthermore, some differences between the results of laminar and turbulent flows have been addressed. The results show that in the laminar flow, unlike the turbulent flow in the improvement regime of heat transfer, the system's thermal performance increases with increasing the wall heat flux, while in the deterioration mode, the two have similar behavior. Moreover, in part of the downward flow, reverse flow occurs, and its length can be understood by using the negative amount of wall shear stress. Furthermore, the thermal efficiency of the supercritical carbon dioxide is better at the upward flow and near the critical point than the constant property flow. In addition, from the applied stepped wall heat flux, it is concluded that the deterioration can be partially controlled or reduced by correctly determining the location of the step or any wall heat flux variations.

کلمات کلیدی:

supercritical fluid, long mini pipe, flow direction, buoyancy effect, wall temperature, stepped wall heat flux