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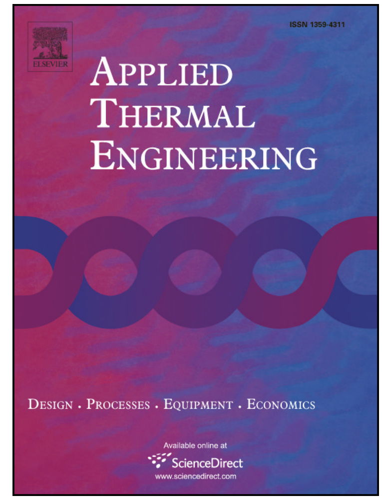

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Flow and heat transfer of supercritical water in the vertical helically-coiled tube under half-side heating condition

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Abstract

Flow and heat transfer of supercritical water in the vertical helically-coiled tube were investigated numerically using RNG *k-ε* model. The inner side of the coil was heated by constant heat flux and the outer side was adiabatic. Heat transfer performance under half-side heating is obtained and compared with that under uniform heating at the same heat transfer rate. Effect of specific heat, secondary flow velocity and buoyancy are discussed. The decrease of specific heat in the near-wall region, and the attenuated turbulence caused by the strong buoyancy force lead to a decrease in heat transfer for half-side heating. The deviations of heat transfer correlations on predicting half-side heating condition are evaluated, and a new heat transfer correlation for supercritical water in the vertical helically-coiled tube under inner half-side heating is proposed. The investigation into different statistical parameters shows that it is superior to the existing correlations.

Key Words: Supercritical water; Helically-coiled tube; Half-side heating; Heat transfer correlation**.**

1. Introduction

A supercritical fluid is any substance at a temperature and pressure above its critical point, where distinct liquid and gas phases do not exist. Thermo-physical properties of supercritical fluids are quite special, a transition from a liquid-like to a vapor-like substance occurs continuously with the increasing temperature, and during this transition, all the properties of the fluid vary significantly. A peak value for specific heat capacity and thermal conductivity occurs at a point, which is called “pseudo-critical point”, but the density and viscosity drastically decrease near that point [1].

Heat transfer at supercritical pressure is strongly affected by the fluid’s thermophysical properties