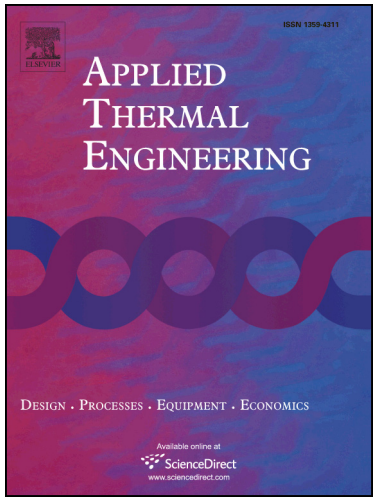

Effect of Heat and Mass Flux on Heat Transfer Characteristics of Water Forced Convection inside Vertical and Inclined Rifled Tubes

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Effect of Heat and Mass Flux on Heat Transfer Characteristics of Water Forced Convection inside Vertical and Inclined Rifled Tubes

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Abstract

In this paper the subcritical and supercritical water flow inside a rifled tube has been investigated experimentally. A comparison between vertical upward flow and a 20 degree inclined upward flow inside a specifically designed rifled tube for various heat and mass flux values has been conducted. The operating pressures for the tests were 15, 21.5, 22.5, 25 and 28 *MPa*, heat fluxes were 300, 400 and 500 kW/m^2 and mass fluxes were 600, 800 and 1000 kg/m^2s. The low mass flux condition has been considered due to its important applications in boiler industries for once-through vertical and spirally wound tubes boilers. The results were shown as inner wall temperature versus fluid bulk enthalpies and convection heat transfer coefficient distribution for various fluid bulk enthalpies for various flow conditions inside the both vertical and inclined tubes. The results showed that the effect of inclination on heat transfer enhancement is incentive for subcritical pressure flows. Also the results showed the higher effect of mass flux on heat transfer in near-critical and supercritical pressures in comparison with the subcritical pressure conditions.

Keywords: Heat transfer; Rifled tube; Vertical upward flow, Inclined tube flow; Supercritical pressures

Introduction

Efficiency quest is under run for electric power generation companies during recent years. Sustainable growths in thermal power plants technologies lead original equipment manufacturers for boilers to higher pressure steam-water boilers. Super-critical and ultra-supercritical thermal power plants which work in high pressure and high temperature conditions and being constructed in many regions all over the world are some examples of this competition. So many researches in this field have been accomplished since 50's till today. These researches are divided to three main categories of: experimental study, numerical analysis and some empirical correlations.

One of the early works in experimental category was performed by Dickinson and Welch [1]. They have studied supercritical water flow in a tube experimentally. Bishop et al. [2] studied heat transfer, DNB, and pressure drop in sub and supercritical pressure region of 1000 to 4000 psia. Some correlations for the test data were introduced by them. Shitsman [3] studied the effect of natural convection on heat transfer from water flow inside a smooth tube at supercritical pressures. Petuhkov [4] investigated the heat transfer and skin friction in turbulent pipe flow with variable physical properties, experimentally. Ackermann [5] showed that a boiling like noise at the onset of heat

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