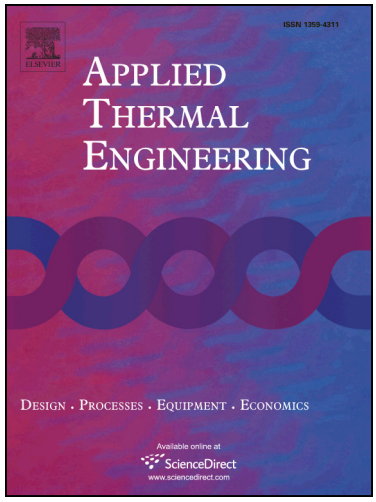

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Flow and heat transfer characteristics of high-pressure water flowing in a vertical upward smooth tube at low mass flux conditions

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Abstract: An experiment that covered a wide range of parameters was conducted to investigate the flow and heat transfer characteristics of water flowing in a vertical upward smooth tube. The effects of the operating parameters on flow and heat transfer were analyzed, and the corresponding empirical correlations were presented. Results show that at subcritical pressures, dryout dominates heat transfer deterioration. This phenomenon can be delayed by reducing pressure and heat flux; however, the effect of mass flux on dryout occurrence is nonmonotonic. At near-critical pressures, departure from nucleate boiling (DNB) occurs at low vapor qualities under high heat fluxes and low mass fluxes. When heat flux increases, DNB occurs early, and peak wall temperature increases significantly. At supercritical pressures, heat transfer is enhanced within the pseudo-critical region, and the heat transfer coefficient peaks correspondingly. When pressure approaches the critical value, heat transfer deterioration occurs at high heat fluxes when the bulk fluid temperature is below and the wall temperature is above the pseudo-critical temperature. Three hydraulic resistance correlations were evaluated using the experimental data, and all three correlations underestimated the frictional pressure drop.

Keywords: vertical upward smooth tube; heat transfer; supercritical pressures; hydraulic resistance

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