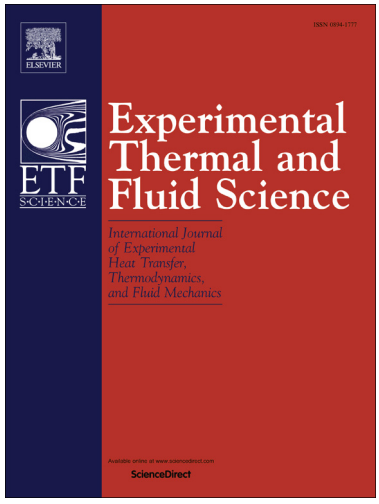

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Experimental Study on Heat Transfer Characteristics of LN_2 Saturated Flow Boiling in a Horizontal Corrugated Tube

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Abstract: The two-phase heat transfer of saturated liquid nitrogen (LN_2) flow boiling in a horizontal corrugated tube was experimentally studied. The experiments were conducted at different inlet pressures of 0.180~0.461 MPa and mass fluxes of 163.1~257.1 $kg \cdot m^{-2} \cdot s^{-1}$ under a wide range of heat flux of 16000~40000 $W \cdot m^{-2}$. The flow pattern was identified to be unstratified flow according to the circumferential distributions of heat transfer temperature differences. Two heat transfer regimes were observed in the present experiment: the nucleate boiling dominated heat transfer and the convective evaporation dominated heat transfer. Due to the thinning of the liquid film at the tube inner surface caused by helical fin, nucleation suppression and convection augmentation were observed and the variation of the circumferential average HTC with the flow parameters became complex depending on the relative importance of the two heat transfer mechanisms. The effects of heat flux, vapor quality, inlet pressure and mass flux on the circumferential average heat transfer coefficient (HTC) are discussed. The results show that the nucleate boiling heat transfer is enhanced with the increase of heat flux, while the convective evaporation is enhanced with the increase of mass flux and vapor quality, and the decrease of pressure. In order to improve the prediction of HTCs, the Klimenko correlation for cryogenic fluids are included in an additive model. Based on the experimental data of circumferential average heat transfer coefficients, the parameterization of the additive model including the convective and nucleate boiling components was obtained for the LN_2 saturated flow boiling in the corrugated tube. Compared to the Klimenko correlation for the flow boiling of cryogenic fluids with a fully