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Two Phase Flow Pattern Map for R290 in Horizontal Smooth Tubes

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As a more efficient and environment-friendly refrigerant alternative, R290 has good environmental characteristics and high thermodynamic performances. It has been used to replace R22 and R502 in the refrigeration industry. The mechanisms of boiling heat transfer and pressure drop are intimately linked with the prevailing two phase flow regime. Therefore, it is necessary to study the two-phase flow pattern for R290, which is related to heat transfer and two-phase flow characteristics.

In this paper, an experimental study of R290 two-phase flow patterns for evaporation in horizontal smooth tubes was presented. The measurements were taken in a 6mm inner diameter horizontal smooth copper tube with length of 500mm. The tests were conducted at various saturation pressure between 0.2MPa to 0.4MPa for different mass fluxes between 70kg/ (m²-s) to 250kg/ (m²-s) in the entire range of vapor quality. The flow patterns were observed by a high speed camera. Three important flow pattern maps were used to compare with the experimental flow pattern data: Steiner, Kattan-Thome-Favrat and Wojtan. It was found that predictions with the flow pattern map of Wojtan agree best with the experimental results of R290. However, the transition curve between annular flow (A) and stratified-wavy flow (SW) was overestimated by the flow pattern map of Wojtan. An improved two phase flow pattern map was proposed for R290. The transition equations of some flow pattern regions are modified in the new flow pattern map.

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