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Investigating Convective Boiling Heat Transfer Characteristics of R-1234ze and R-134a Refrigerants in a Microfin and Smooth Tube

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Abstract : This research is based on R-1234ze that is considered to substitute R-134a due to its low global warming potential in a microfin tube with outer diameter 9.52 mm, number of fins 70, and fin height 0.17 mm. In comparison, a smooth tube with similar geometries was used to study pressure drop and heat transfer coefficients related to the two fluids. The microfin tube was brazed inside a stainless steel tube and heated electrically. T-type thermocouples used to measure the temperature distribution during the phase change process. The experimental saturation temperatures and refrigerant mass velocities varied from 10 – 20°C and 50 – 300 kg/m2s respectively. The vapor quality from 0.1 to 0.9, and heat flux ranged from 5 – 11kW/m2. The results showed that heat transfer performance of R-134a in both microfin and smooth tube was better than R-1234ze especially at mass velocities above G = 50 kg/m2s. However, at low mass velocities below G = 100 kg/m2s R-1234ze yield better heat transfer coefficients than R-134a. The pressure gradient of R-1234ze was markedly higher than that of R-134a at all mass flow rates.

Keywords : R-1234ze and R-134a, horizontal flow boiling, pressure drop, heat transfer coefficients, micro-fin and smooth tubes
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