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An Experimental Study On Evaporation Heat Transfer And Pressure Drop Of R-1234ze(E) In A Disk Type Plate Heat Exchanger

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Extended Abstract

In order to reduce greenhouse gas emission, conventional refrigerants with high global warming potential need to be replaced according to international agreements such as Kyoto Protocol and F-gas regulation [1-2]. In accordance with this global trend, numerous researches on the alternative refrigerants have been conducted. Hydrofluoroolefin (HFO) refrigerants such as R-1234ze(E) and R-1234yf have been nominated as powerful candidates for the substitute refrigerants with low GWP because of their short atmospheric life time due to double bond between carbons [3]. Papers that analyzed properties and basic heat transfer and flow characteristics of HFO refrigerants have been published extensively [4-5]. However, studies of R-1234ze(E) in various kinds of heat exchangers are still limited, which should be conducted for practical applications of the alternative refrigerants [6]. Therefore, evaporation heat transfer and pressure drop characteristics of R-1234ze(E) in a disk type plate heat exchanger are investigated in this study. A plate heat exchanger has been widely used as a heat exchanger in a heat pump, power cycle and food treatment industry due to its compactness, high cost effectiveness and heat exchange efficiency [7]. The disk type plate heat exchanger is one kind of the plate heat exchanger and it can sustain higher operating pressure than brazing type plate heat exchanger. In this study, the system that can measure the heat transfer and the pressure drop in the disk type plate heat exchanger is constructed using the refrigerant pump for circulation of the refrigerant, the pre-heater for the vapor quality control and the cooling chiller for the operating temperature control. Four parameters were set as variables for operating conditions; temperature ranged from 5 to 15°C, heat flux ranged from kW m^{-2}, mass flux ranged from 10 to 20kg s^{-1} m^{-2} and vapor quality ranged from 0.1 to 0.9. The frictional pressure drop depended highly on the vapor quality while the heat transfer coefficient showed trivial dependence on the vapor quality. The increase in the mass flux results in enlarged pressure drop and heat transfer coefficient due to intensified turbulence of the refrigerant. The heat transfer coefficient increased but the slope of the graph decreased with increasing heat flux. Opposite to the trend of the heat transfer coefficient, the pressure drop remained nearly constant with respect to the heat flux. The result and the experimental data of this study could be utilized for designing or estimating capacity of an evaporator with R-1234ze(E) and for numerical study on the system with R-1234ze(E).

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