Experimental results for hydrocarbon refrigerant vaporization inside brazed plate heat exchangers at high pressure - DTU Orbit (13/12/2018)

In recent years the interest in small capacity organic Rankine cycle (ORC) power systems for harvesting low quality waste thermal energy from industrial processes has been steadily growing. Micro ORC systems are normally equipped with brazed plate heat exchangers which allows for efficient heat transfer with a compact design. An accurate prediction of the heat transfer process characterizing these devices is required from the design phase to the development of model-based control strategies. The current literature is lacking experimental data and validated correlations for vaporization of organic fluids at typical working conditions of ORC systems for low temperature waste heat recovery (WHR) applications. Based on these premises, a novel test rig has been recently designed and built at the Technical University of Denmark to simulate the evaporating condition occurring in a small capacity ORC power unit. In this contribution the preliminary experimental results obtained from the first experimental campaign carried out on the rig are reported. HFC-134a was selected as working fluid. The experiments were carried out at saturation temperature of 60, 70 and 80 °C and inlet and outlet qualities ranging between 0.1-0.4 and 0.6-0.95 respectively. The heat flux ranged between 19.4 and 43.1 kW m⁻². The results are presented in terms of refrigerant side heat transfer coefficient and pressure drop. The heat transfer coefficient showed significant sensitivity to the saturation temperature and was characterized by a decreasing trend with respect to the mean evaporator quality. The frictional pressure drop showed a linear dependence on the mean quality value and increased as the saturation temperature decreased. The experimental heat transfer coefficients were compared with a well-known correlation for nucleate boiling which significantly underestimated the founded values.

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