Modelling distribution of evaporating CO2 in parallel minichannels

The effects of airflow non-uniformity and uneven inlet qualities on the performance of a minichannel evaporator with parallel channels, using CO2 as refrigerant, are investigated numerically. For this purpose a one-dimensional discretised steady-state model was developed, applying well-known empirical correlations for calculating frictional pressure drop and heat transfer coefficients. An investigation of different correlations for boiling two-phase flow shows that the choice of correlation is insignificant regarding the overall results. It is shown that non-uniform airflow leads to maldistribution of the refrigerant and considerable capacity reduction of the evaporator. Uneven inlet qualities to the different channels show only minor effects on the refrigerant distribution and evaporator capacity as long as the channels are vertically oriented with CO2 flowing upwards. For horizontal channels capacity reductions are found for both non-uniform airflow and uneven inlet qualities. For horizontal minichannels the results are very similar to those obtained using R134a as refrigerant.