Comparative Study on the Performance of Three- and Four-Parameter Correlations of the Enthalpy of Vaporization for Pure Substance Refrigerants

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A few commonly used correlation equations of the enthalpy of vaporization which are essential to the analysis of refrigeration cycles are reviewed. A new four-parameter correlation equation is proposed assuming that the enthalpy of vaporization could be represented with a linear term with respect to the temperature and an additional function which marginally decreases with temperature. It is not a common practice to measure the enthalpy of vaporization by experiment; therefore, the performance of the new correlation is examined using numeric data from the ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) tables for 22 pure substance refrigerants. The new correlation equation and other existing equations are fitted to the data optimizing the root mean squared deviation. All data points are weighted equally and NBP (normal boiling point) is used as a fixed point, since the NBP is important for refrigeration applications. The new four-parameter equation yields an average absolute deviation of 0.05 % for 22 refrigerants, which is better than those of other four-parameter equations, such as the Guermouche-Vergaund (0.08 %), Aerebrot (0.13 %), Radoz-Lyderson (0.08 %), and Somayajulu (0.08 %) four-parameter equations. After the optimization, it is found that a specific exponent in the new equation has approximately the same number for almost every substance tested, so that the original four-parameter correlation could be reduced to a three-parameter one. The new three-parameter correlation yields an average absolute deviation of 0.14 % for the same 22 refrigerants, which also is better than those of other three-parameter correlations, such as the Xiang (0.18 %), Majer-Svoboda-Pick (0.18 %), and Somayajulu (0.23 %) three-parameter equations.