Performance Enhancement of Vapor Compression Heat Pumps by a Cooled Compression Cycle

The presented study proposes a configuration combining the compression and condensation processes in a single unit and evaporation and expansion in another separate unit for application in a vapor compression heat pump cycle. The cycle includes injection of refrigerant into the compressor at a certain temperature. This system makes it possible to match the temperature glide of the heat sink and source and simultaneously condense the refrigerant during the compression. A mathematical model of a complete cycle was made to study the system parameters and performance improvement of the cycle. Moreover, thermodynamic models of compression-condensation processes as well as a sensitivity analysis were developed to investigate the heat transfer inside the compressor-condenser unit and determine the injection conditions which can achieve the desirable requirements in the cycle model. Advantages such as eliminating thermodynamic losses associated with the desuperheating of refrigerant, reduction of compression work, available hot liquid at the compressor outlet for the district heating system and COP closer to the Lorenz COP can be obtained compared to the conventional cycle. The proposed cycle reached COP of 4.1 and 59 % Lorenz efficiency for a case related to R717 as working fluid and district heating production.

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