

Coefficient of Performance (COP) Optimization of an R134a Cross Vane Expander Compressor Refrigeration System

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Abstract : Cross Vane Expander Compressor (CVEC) is a newly invented expander-compressor combined unit, where it is introduced to replace the compressor and the expansion valve in traditional refrigeration system. The mathematical model of CVEC has been developed to examine its performance, and it was found that the energy consumption of a conventional refrigeration system was reduced by as much as 18%. It is believed that energy consumption can be further reduced by optimizing the device. In this study, the coefficient of performance (COP) of CVEC has been optimized under predetermined operational parameters and constrained main design parameters. Several main design parameters of CVEC were selected to be the variables, and the optimization was done with theoretical model in a simulation program. The theoretical model consists of geometrical model, dynamic model, heat transfer model and valve dynamics model. Complex optimization method, which is a constrained, direct search and multi-variables method was used in the study. As a result, the optimization study suggested that with an appropriate combination of design parameters, a 58% COP improvement in CVEC R134a refrigeration system is possible.

Keywords : COP, cross vane expander-compressor, CVEC, design, simulation, refrigeration system, air-conditioning, R134a, multi variables

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