Hybrid Thermoelectric Ejector Refrigeration System

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Abstract

A mathematical model is developed to predict the refrigeration performance of an ejector powered by waste energy from a thermoelectric cooler. The model is based on constant pressure mixing process and considers the effect of frictional loss, viscous effect and shock wave phenomenon. Using this model, effects of nozzle exit position, temperatures of low and high temperature evaporators, area ratios, and working fluid on the system performance can be predicted. An Experiment is set up and at steady state, effects such as operational conditions, nozzle exit position and critical condensing pressure on performance of the system were studied. The experimental results were compared with investigations conducted by other researchers and with theoretical prediction.

The investigated system utilizes capillary force generated by thermal energy to produce the pumping capability to pump the working fluid. A mathematical model is developed to predict the capillary flow and ensure the circulation through the entire system from the condenser, through the low-temperature evaporator to the high-temperature evaporator. Using the waste energy generated from the hot side of the thermoelectric cooler, the coefficient of performance (COP) of the hybrid system can be highly increased and used for electronic cooling.