

Performance of Thermoelectric Module as a Water Cooler and Water Heater

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Abstract

This paper presents the total Coefficient of Performance (CoP) of a thermoelectric module in combined heating and cooling modes, obtained through experiments and thermodynamics mathematical model. Thermoelectric module is a solid state heat pump which has a capability to pump heat with the capacity of 100 W or lower. One of the module surface will acts as a heat sink while another surface of the module rejects heat. This provides an opportunity to utilize both surfaces for cooling and heating applications. The objective of this work was to determine the total CoP of the thermoelectric module when it was operated in a combination of heating and cooling modes. The total CoP was inferred by fitting the temperature of cold and hot water streams which were obtained from experiments to a mathematical model of the thermoelectric heating and cooling system. The highest temperature difference between hot and cold streams was 40 Kelvin. The worst root-mean-square error between the measured and calculated temperature was 2 Kelvin, except for the hot stream temperature curve in the Condition 1 (RMS error was 3.5 Kelvin). It was proved that the total CoP of 4.5 was achievable for thermoelectric module operated in the combined heating and cooling modes. However, the total CoP decreased as the temperature difference between hot and cold streams was increased. It can be concluded that the use of thermoelectric module in heating and cooling modes can improve its CoP which contribute to saving in electrical consumption by the module.

Author keywords

Coefficient of Performance; Cooling; Heating; Thermoelectric module

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