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Experimental investigations on a portable fresh water generator using a thermoelectric cooler

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Abstract

The main objective is to develop and experimentally investigate a thermoelectric fresh water generator (TFWG) based on the fundamental of Thermoelectric Cooling Effect by condensing the moisture from the ambient moist air. It can be made useful to the people in coastal and humid regions with relative humidity above 60 % having scarcity of drinking water. A prototype of the generator consisting of a 0.7 m long cooling channel along with ten thermoelectric modules of dimension 0.04 * 0.04 m2 each placed linearly in an array is fabricated and experimented. An internal heat sink of surface area 0.2m² and length 0.65m is placed on the cold side of the modules to enhance heat transfer rate. The observations from the experiments show that with the use of internal heat sink, the quantity of water generated per 10 hours increases by 81% as compared without internal heat sink. Electric current, air mass flow rate and humidity of moist air were varied to understand their impact on the quantity of water generated. Based upon the observed results, the quantity of water generated is directly proportional to all the three parameters in the domain of experimentation.

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Keywords: Thermoelectric cooling; dehumidification; fresh water production; peltier;

1. Introduction

The world is facing the era of scarcity of fresh water. More than 1.2 billion people lack access to clean drinking water. By 2030, almost half the world's population will be living in water stressed conditions [1]. Water scarcity is both a natural and a human-made phenomenon. The areas having water shortages contribute to poverty.

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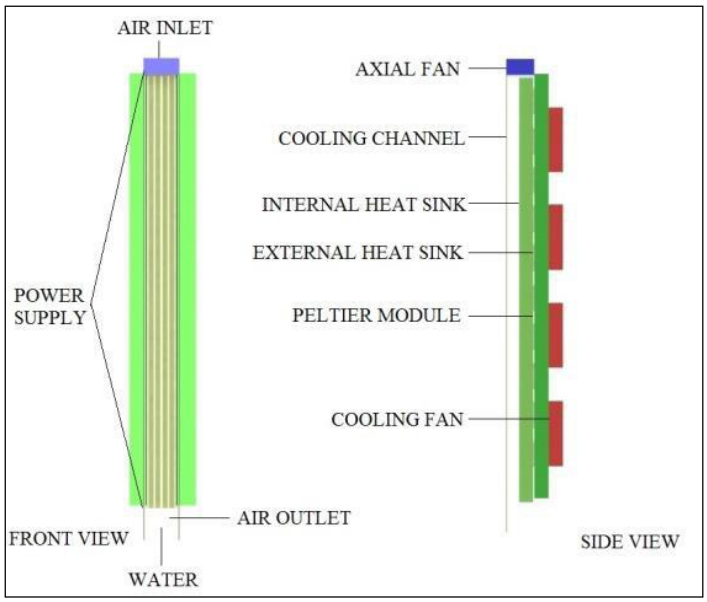

Fig. 1. Schematic diagram of system

One of the methods of generation of fresh water is by condensing the moisture from the atmosphere, which can be made useful to the people in humid and coastal regions of world having scarcity of water. A sustainable solution for condensation of moisture is by using thermoelectric cooling technology.

Very few researchers have examined thermoelectric dehumidification. J.G. Vian et al. [2] have designed and developed a prototype of a low power (100W) thermoelectric dehumidifier using three peltier modules. Their system

Nomenclature

A	ampere of current
ml	millilitre
V	volts
COP	coefficient of performance

was optimized using (AERO) computational calculation model. M.A. Muñoz-García et al. [3] have developed a system which can be made useful for water harvesting for young trees by using peltier modules powered by photovoltaic solar energy. M. Jradi et al. [4, 5] have developed of a prototype of an integrated thermoelectric-photovoltaic renewable system to dehumidify air and produce fresh water using thermoelectrically cooled TEC channels. They have also demonstrated the feasibility of implementing five TEC channels in Beirut, Lebanon climate for producing 10 liters of water per day over the summer months wherein each TEC channel consists of twenty peltier modules.

The objective of the current work is to experimentally investigate a thermoelectric fresh water generator and enhance its performance by using internal heat sink.

2. System Description

The schematic diagram of thermoelectric fresh water generator (TFWG) is presented in Fig 1.TFWG consists of a 0.7m long cooling channel of cross section 0.05m*0.045m, made up of Peltier modules, external heat sink, cooling fan on the external heat sink, axial fan and an internal heat sink. The weight of the setup shown in Fig 2(c) is 10.6kg.