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Atmospheric Water Generation from Humidity

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Abstract

Sometimes the terrible water scarcity creates a serious problem. Despite the fact that water covers more than two third of the earth's surface yet at the same time fresh water which can be utilized for drinking stays rare. The main objective of this project is to create a product that is able to produce safe and clean drinking water while only using air and energy. The problem of thesis concerns the nature, technology and process of the actual extraction. The point of the project is to make a versatile gadget using thermoelectric cooler that can be utilized to meet the drinking water prerequisites. The gadget will first consolidate water available in the air and after that purification unit can be introduced to this gadget for fresh drinking water. A solar powered AWG system is built using a TE cooler, solar panels heat exchange unit and digital control unit. Using solar panels with Peltier cooler is more productive as far as effectiveness and its power utilization and its voltage is effectively controllable. The system is self-powered and can be used in costal and hilly areas to produce water from surrounding humid air. We expect that the water output from AWG depends on the amount of relative humidity of the atmosphere.

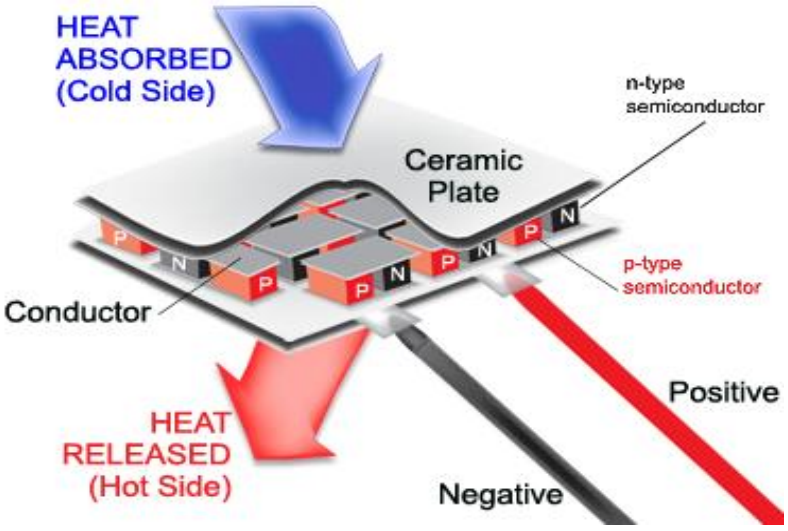
Keywords*: - AWG, TE Cooler, Humidity, Thermoelectric cooler, Peltier cooler*

INTRODUCTION

In many countries like India it is difficult to obtain water resources for irrigation or other purposes, especially in the arid regions. The problem of water scarcity is also observed in other places of the world due to lack of rainfall. However, in highly humid areas such as places close to the sea, water can be obtained by condensing the water vapour present in air. Here, the paper presents the method to develop a water condensation system based on thermoelectric cooler.

The system consists of cooling elements, heat exchange unit and air circulation unit. A solar cell panel unit with a relevant high current output drives the cooling elements through a controlling circuit. Atmospheric Water Generator is a device that can convert atmospheric moisture directly into usable and even drinkable water. It is such a device which uses the principle of latent heat to convert molecules of water vapour into water droplets. It has been introduced a bit before, though it is not very common in India and some other countries. It has a great application standing on such age of technology where we all are running behind renewable sources. This paper also describes the experimental results and the system's performance.

The device uses the principle of latent heat to convert water vapour molecules into water droplets. In many countries like India, there are many places which are situated in temperate region; there are desert, rain forest areas and even flooded areas where atmospheric humidity is eminent. But resources of water are limited.



In the past few years some projects have already been done to establish the concept of air condensation as well as generation of water with the help of Peltier devices, such as harvesting water for young trees using Peltier plates that are powered by photovoltaic solar energy , etc. So, this project will be helping to extend the applications of such devices further in the near future.

According to previous knowledge, we know that the temperature require to condense water is known as dew point temperature. This project consists of a thermoelectric Peltier (TEC) couple, which is used to create the environment of water condensing temperature or dew point, indeed conventional compressor and evaporator system could also be used to condense water by simply exchanging the latent heat of coolant inside the evaporator.

The condensed water will be collected to use for drinking purpose and various other uses. Peltier Cooler The Peltier thermoelectric device has two sides(a p-type and an n-type semiconductor), and when DC current flows through the device, it brings heat from one side to other, so that one side gets cooler while the opposite one gets hotter. This is called Peltier effect and electron hole theory. Peltier coolers consist of a Peltier element and a powerful heat sink/fan combination. Peltier elements come in various forms and shapes. Typically, they consist of a larger amount of thermocouples arranged in rectangular form and packaged between two thin ceramic plates. This type of device is so powerful that it can freeze good amount of the water within several minutes.

A TEC also has some analogous parts. Energy (heat) is absorbed by electrons at the cold junction, as they pass from a low energy level in the p-type semiconductor element, to a higher energy level in the n-type semiconductor element. It is the power supply that provides the energy to make those electrons to move through the system. At the hot junction, energy is expelled to a heat sink as electrons move from a high energy level element (n-type) to a lower energy level element (p-type).

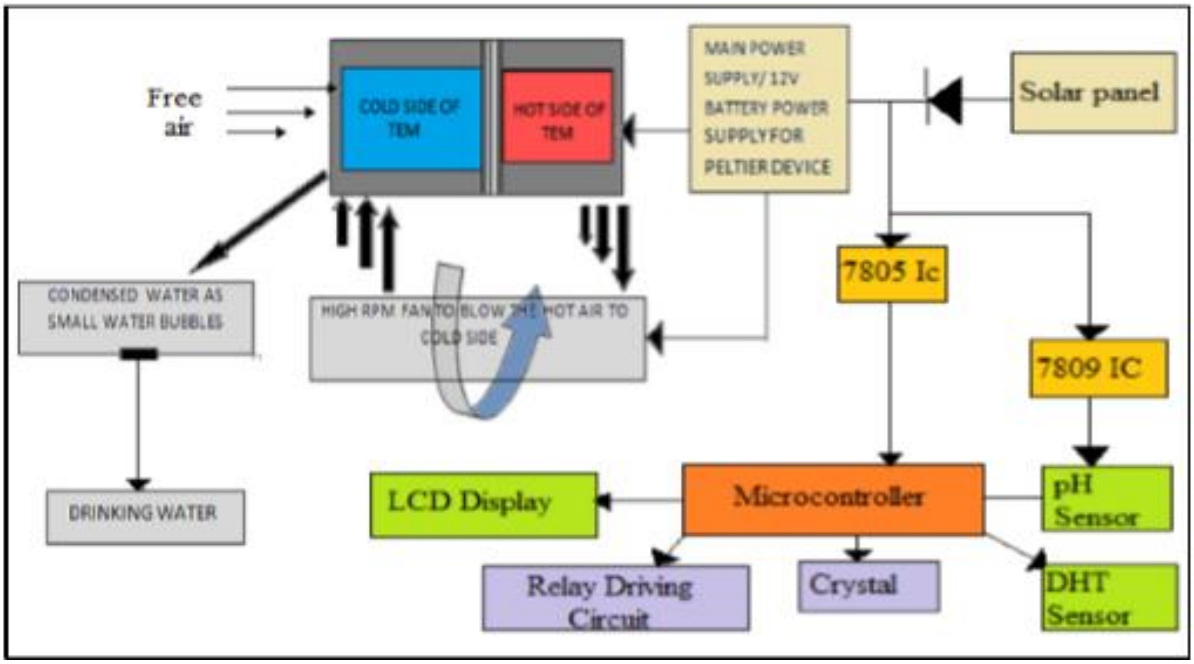
METHODOLOGY

Air capacity of holding water-vapour varies according to the temperature of the air and humidity. The warmer the air, the more water-vapour it can hold. The moisture air is pumped first into the tube thus the cold side of the Peltier element helps to decrease the air temperature. So, as the air cools down, its capacity of holding water decreases and water

moisture starts condensing. The air is then passed through to the hotter side of TEC that cools the temperature of hot side, as shown in below figure.

This is necessary to keep running of Peltier device; otherwise the temperature will increase at hot side so much that the device could be damaged. This warm air can be sent to the cooler side to increase the water generation, as described earlier. The condensed water falls into a reservoir then passes through a filter. When testing an assembly of this type it is important to monitor temperature and relative humidity. Measuring the temperature and the humidity of the cooling inlet and outlet air as well as flow rates is necessary to build a closed loop control unit.

It is built using TC1046 Sensor and a PIC16F872 or ATmega series microcontroller to control the system and keeping the temperature of the circulating air above the water freezing point. It senses the temperature of two sides of TEC1 by using two temperature sensors and accordingly follows an algorithm to control the fan's speed as well as system safety.



RESULT:

Applying this system in a highly humid region we can extract almost 100ml of condensed water can be produced per hour during the day light, this is a promising result for a prototype. A more enhanced system can be designed that encounters higher power solar cells and Peltier device of higher amperes which will result in more amount of water. It also has the capability to store the excess energy during the day light using a battery that is to be used at night. The below table shows the projected volume of water [in l] from $1m^3$ air in various humidity conditions and temperatures.

Temp [c]	Humidity [%]							
	30	40	50	60	70	80	90	100
25	4	6	8	10	12	15	16	18
30	6	8	10	12	13	16	19	21
35	9	11	14	17	19	21	24	28
40	12	15	17	19	23	28	30	33
45	15	19	24	28	33	36	41	48

Amount of water [in litres]

CONCLUSION:

By applying this system to a densely humid region we can extract more amount of water from atmosphere. The design is more convenient for water collection. Using solar cell we can store energy at day light and use in night. The design is so simple such that the device can be carried to anywhere. The equipment is very helpful for explorers, mountaineers fishermen etc. The concept of this system can also be used as a better alternative in refrigeration against conventional systems. At the current climatic conditions as global warming increases and the water resources over the world diminishes, so this equipment is extremely helpful to mankind.

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Dr. K. Gopala Reddy obtained his B.E. and M.E. degree in NIE, Mysuru and MCA in IGNOU, SJCE, Mysuru. He joined Vidya Vardhaka college of Engineering in the year 2007 as lecturer, promoted as senior grade lecturer in the year 2009, Asst. Professor in the year 2011 and now he is working as Associate Professor in Electrical and Electronics Engineering department till date. He has 25 years of teaching experience. He is life member of ISTE and Institution of Engineers. He has presented 10 papers in international conferences and 18 papers in International journals. His research title is "Development of Intelligent techniques for optimal distributed generation planning for power quality improvement in distribution network". He is also the author of text books **"Electric Motors"** for IV semester, **"Transformers & Generators"** for III semester and **"Testing & Commissioning Of Power System Apparatus"** for VII semester students.