Solar Powered Atmospheric Water Generator By Using Thermo-Electric Couple

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Abstract*:* We introduce an Atmospheric Water Generator which works on the principle of Thermo-Electric Couple (TEC) Device. According to the Previous Research papers we had studied that we can extract water from atmospheric air. We noticed that the water can be produce from highly relative humidity air with moderate atmospheric temp. It is highly applicable in desert area, in sea, rural area, etc.

Key words: Solar energy, Thermo-Electric Device, Peltier Effect, Dew Point formation, Water Generation.

INTRODUCTION

The Atmospheric Water Generator is used where pure water scarcity. This device is used to convert atmospheric air into water with high relative humidity. This is done by decreasing the temp. of air till dew point temperature and coverts atmospheric moisture directly into clean drinking water form by condensing the latent heat of water vapour into water droplets. The above procedure is done with the help of peltier module which is used as thermo-electric device. Atmospheric water generator (AWG) does not apply vapour compression cycle to extract water vapour from surrounding air. In this project we use peltier device & it reduces compressor and condenser usages. This leads to reduce spacing, size and weight of the equipment, so we use peltier device to extract water from atmospheric air.

LITERATURE REVIEW

Matthieu Cosnier (2008) presented an experimental & nume rical study of thermoelectric air-cooling & air-heating system. They have reached a cooling power of 50W per module, with a COP between 1.5 to 2 by supplying an electrical intensity of 4A maintaining the 5 degree Celsius temperature difference between the hot & cold sides.

P. Ancey, M. Gshwind (1995) presented New Concept of Integrated Peltier cooling device for the Preventive Detection of Water Condensation

Mr. Swapnil B. Patond , Miss. Priti G. Bhadake (2015) presented an Experimental analysis of solar powered Thermo-electric Heating & Cooling System

Prof. Pushkarny B.H. (2016) presented Solar Refrigeration using Peltier Effect.

Prof. Vivek R. Gandhewar, Mr. Mukesh P. Mangtani (2013) , “Fabrication of solar operated heating & cooling system using thermo-electric couple”.

AIM & OBJECTIVE

Our main aim is to extract water from atmosphere using peltier effect.

The main objective of this project is to create a product that is able to produce safe & clean drinking water while only consuming air & energy. From this we can extract water without compressor & condenser. The project is an attempt to provide drinking water to the people where there is shortage of pure and fresh drinking water.

CONSTRUCTION

The construction setup of the AWG is as follows,

a) Solar Panel
b) Heat Pipe & Exhaust Fan
c) Peltier Module (TEC1-12706)
d) Battery
e) Stainless Steel Cone
f) Water Collector

A) Solar Panel:**-** In the construction solar cell is located at the top of the model which direct converts solar energy into electrical energy by conversion of light or other electro-magnetic radiation into electricity.
B) Battery:**-** The direct supply of solar cell is to the battery for charging an main purpose of the battery is to provide electric supply for peltier plate and heat pipe exhaust fan.
C) Heat Pipe & Exhaust Fan:**-** Exhaust fan is attached to heat pipe and it is used for transfer the heat from hot side of peltier plate to the atmosphere and it located on the hot side of peltier module.
D) Peltier Module:**-** In construction we have used TEC1-12706 solid state peltier module and it is located below the heat pipe in which hot plate is at upper side and cold plate is at bottom side.
E) Stainless Steel Cone :**-** The main purpose of stainless steel cone is to collect the moisture, droplets of water in the container and it’s located below the cold side of peltier plate.
F) Water Collector :**-** It is used to collect the water droplets from stainless steel cone.

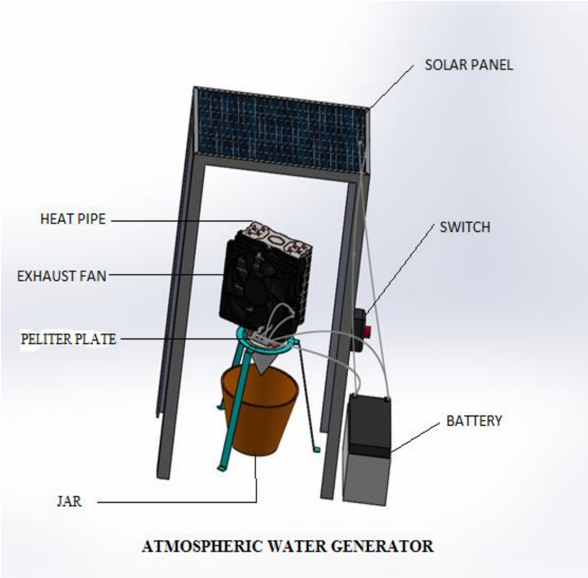

Fig.1 Overview of Atmospheric Water Generator

Fig.2 Fabricated Atmospheric Water Generator

WORKING PRINCIPLE

The main parts used in this project are Peltier module, Heat Pipe with Exhaust fan. The working of the peltier module is based on the peltier effect proposed by Jean-Charles Peltier, a French Physicist in 1834.

As we supply current through battery to the peltier module,, heat is evolved at upper junction & adsorbed at the lower junction & therefore the upper side get hot & lowers side get cooled. After some time as we reached at dew point temperature the condensation starts or moisture at stainless steel cone is executed. After this moisture is converted into water droplets this can be collected in the container

At the same time, at upper side of the peltier module is get hot. But we have use the heat pipe with exhaust fan to transfer the hot side heat to the atmosphere. At starting we supply electric current to the peltier module and exhaust fan simultaneously. As the bottom side of the peltier module get cooled and at the same time the upper side of peltier module get hot and without heat pipe it is impossible to cool the lower side of heat pipe. Condensation of the air starts after dew point temperature. As we reach dew point temperature condensation starts and moisture is formed on the SS cone and water is collected in the form of droplets in container. The amount of water collected in the container is depend upon the relative humidity present in the atmosphere.

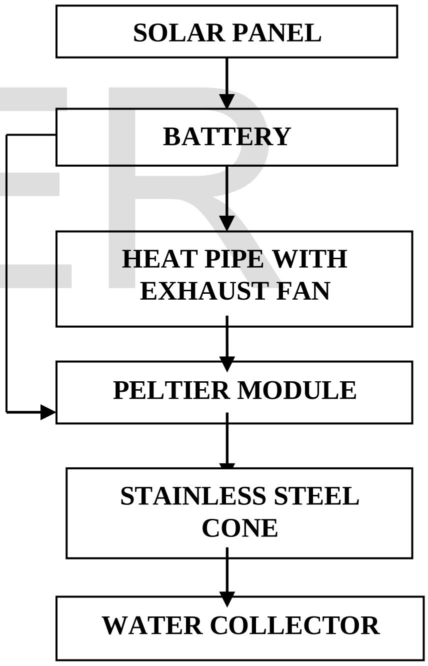

Fig.3 Block diagram of AWG

CALCULATIONS

EQUATIONS:-

By taking references from Research Papers,
Assuming Specific humidity =0.012 Kg of water /kg of Dry air.

From 1 Kg of dry air 0.0048 kg of water is extracted.
$¥(T,RH) = \ln (RH/100) + (b \times T)/(c+t)$

Dew point temperature (Tdp) = $[c \times ¥(T,RH)] / [b-¥(T,RH)]$
Where b=17.67 & c=243.5ºC

RH= $Pw/Ps \times 100$

Pw= /100 x Ps

Humidity Ratio =$0.622 \times Pw/(Pn-Pw)$

SAMPLE CALCULATION:-

Relative Humidity in Mumbai = 37% for temperature = 28^0C

$¥ (T,RH) = \ln (RH/100) \times bT/((C+T))$ ..(Magnum Equation)
$= \ln (37/100) + (17.67 \times 28) / (243.5 \times 28)$
$¥ (T,RH) = 1.3905$

Dew Point Temperature = $(C\ X\ ¥ (T,))/(b-¥ (T,RH))$
$T_{dp} = 20.79\ ^0$ C.

Now With the help of the value of relative humidity ratio , we can calculate amount of water in 1 m³ of air.

Partial Pressure of Water Pw= $RH/100 \times Pa$
$= 37/100\ X\ 0.03864$
$= 0.01429$

Humidity Ratio = $0.622\ X Pw/(Pa-Pw)$
$= 0.01429/(1.013-0.01429\ )\ X\ 0.622$
$= 8.9\ X\ 10^{3}$
Amount of Water (mL) = 8.9mL

ADVENTAGES

- No moving parts, so maintenance is required less frequently.
- No use of chlorofluorocarbon.
- It can help to solve the problem of water scarcity.
- It is portable and can be used almost anywhere
- It saves money in terms of electricity consumption.
- No use of compressor and condenser, so that initial setup cost is reduced.
- Less space is required for Installation.

CONCLUSION

By applying this system we have conclude that from highly humid region we can extract more amount of drinking water from atmospheric air. The use of this system may result in solution for drinking water problem in many situations without high infrastructure setup cost and time needed. It could create additional portable drinking water without any external sources like compressor, condenser, etc.
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