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SWITCHING MODE ATMOSPHERIC WATER EXTRACTOR

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Abstract - A switching mode atmosphere water extractor is a device which employs condensing or dehumidification technology that extracts water from the humidity present in the air. A switching mode atmosphere water extractor works on the principle of condensing the atmosphere air by cooling the air below its dew point temperature. The device is planted eight or more feet into the ground, and soil is then packed around its neck. The top of the extractor holds a vertical tapered wind turbine, which helps to draw air into the sub-terrain chamber below the earth. The underground chamber portion of the device is cooled by the surrounding earth, water condenses in the reservoir to creates an artificial well, from which people can draw clean water . The water extracted is then filtered through different filters in order to get fresh and safe drinking water. The switching mode helps to spin the turbine with the help of simple motor when there is a scarcity of wind during the day, which can be powered by a solar battery energy. Our main objective is to provide clean and safe drinking water to the places where scarcity of water is more. We hope our project will solve the problem of water scarcity by providing an atmosphere water extractor using renewable resources.

Keywords:- water extractor,turbine,extraction net

I. INTRODUCTION

India is the second most populous country in the world, with more than 1 billion citizens and is at a critical point in providing clean, safe Water to its citizens. Water crisis increases when the supply of water is less than the demand due to non-availability of water or mismanagement of water resources. According to the United Nations Water Development Report 2016, one of the most serious problems the humanity is facing today is the scarcity of fresh water.

The atmosphere contains water in the form of water vapor, moisture, etc. Switching mode atmosphere water helps to extract this water present in the atmosphere. This device helps to cool the air below its dew point temperature. Which enable the water vapor or moisture content present in the atmosphere to condense and to form water droplets. Water thus formed can be used for daily purposes, even as drinking water after filtering. In India most of the places are situated in temperate region which increases the water scarcity. Since warm air contains more humidity than cold air, it helps to extract water more easily.

This project helps to decrease the water scarcity in those regions. We know that the temperature require to condense water as dew point temperature. Here, the main goal is to obtain that specific dew point temperature to condense

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water. This project consists of a vertical tapered turbine which enables us to direct the air flow towards the chamber, an extraction net, and an underground chamber which helps to condense that moisture and store it for further use.

II. WORKING PRINCIPLE

A switching mode atmosphere water extractor works on the principle of condensing the atmosphere air by cooling the air below its dew point temperature. It relies on simple condensation processes to collect clean water from the atmosphere and does so without using any power source. We know from earlier studies that as the depth from the soil increases temperature decreases, i.e. at a depth of 7ft from the soil surface the temperature of soil is less as compared to the temperature above it.This enables air to condense the moisture by directing air towards the chamber. At an average temperature of 28^{o}C and the dew point temperature to be 21^{o}C, which can be easily attained though this method.

The metal pipe and the soil surrounded act as a heat exchanging medium. The metal sides of the underground chamber are cooled down by the surrounding soil. As the air passes downwards through the metal pipe it loses its heat to the surroundings and attain dew point temperature, thus helps to condense the moisture and form water droplets. The metal used here is aluminum which has more thermal conductivity than other metals. As the water vapor cools in the chamber, the water vapor condenses onto the sides of the metal pipe, flowing down toward the reservoir. As the sides of the underground chamber are always cooler than the air that enters into the device, it can collect water both day and night even when there is no wind.

III. OPERATION (EXPERIMENTAL SETUP)

A switching mode atmosphere water extractor is relatively simple device, designed to be operated with or without an external power input and without costly chemicals. It is completely non-polluting and its simple construction is inexpensive and maintenance free. The device can pull moisture from thin air and condense at ant water using the temperature difference between the above-ground turbine and the collection chamber installed seven feet underground. The potable water can then be delivered to the surface for use via a simple pump and hose.

Case 1: During windy days with the help of wind power the turbine spins and direct air towards the chamber, on the way to the chamber as the air passes through the pipe the humid air gets condense onto the sides of the chamber and get deposited in to the chamber/reservoir. Since the chamber is placed at a place where the temperature is lower than the outside temperature it helps to condense the air to form small water droplets. These water droplets are collected in the reservoir/chamber for further use.

Case 2: Since winds doesn't blow every time in a day, the amount of water produced in the extraction can be less.in order to compensate this problems a small dc powered motor is introduced into the device which helps to turn the turbine wanes to spin and direct the air towards the chamber. The motor is powered by solar energy or from a 6v power rechargeable battery. The introduction of water even in the non-windy days.

The wind turbine blades are placed in such a way that it directs the air directly into the chamber path.

The metal pipe which is made up of aluminum helps to exchange heat between the air and the soil. Soil which surrounds the pipe keeps a temperature below the surface temperature so that the air can easily attain dew point temperature.

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The extraction nets are placed just below the wind turbine so that the directed air supply passes through the net before getting in to the chamber path. Extraction nets give an extra area for the moisture to condense this condensed water droplets are directed towards the chamber/reservoir through a funnel. Extraction nets are made up of hydrophilic polypropylene fibers which have the ability to trap the moisture present in the atmosphere.
Both the metal pipe and the extraction net contribute to the production of water in the device. Condensed water that is collected in the underground chamber is taken out using hand pump or foot pump.
This extracted water may contain impurities which can be removed by using filters which are filtered on the device. Thus clean and safe drinking water is extracted from the atmosphere using this device.

IV. RELATIONSHIP BETWEEN HUMIDITY AND TEMPERATURE

The amount of water vapor present in the air may be different at different temperature relations. By calculating relative humidity we can calculate the amount of water vapor content present in the atmosphere. The relative humidity is defined as the amount of water vapor present in air expressed as a percentage of the amount needed for saturation at the same temperature .The formula for relative humidity is
Relative humidity (%) = Moisture content present in the air at present condition / Maximum possible moisture content that air can hold at the current temperature condition (x100)
So more the humidity in air and cooler will be the surrounding temperature, the more will be the water output from the atmosphere water extractor. This graph shows the relative humidity and temperature relationship:

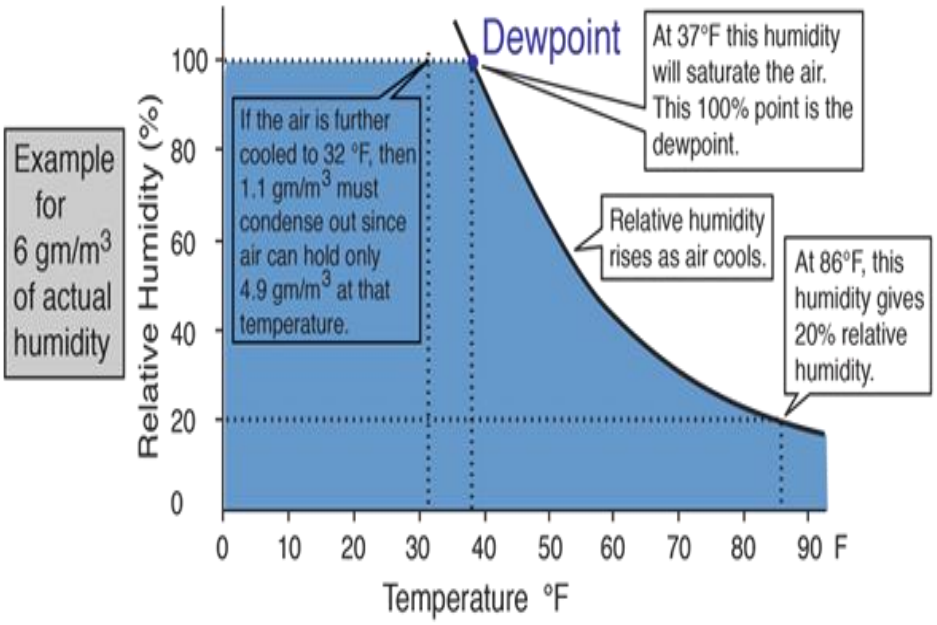

Fig: 1

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V. KEY PARTS OF THE PROJECT

A. WIND TURBINE

In switching mode water extractor wind turbine plays an important role that it helps to direct the surrounding air towards the chamber where the condensation of the humid air occurs. The wind turbine blades are so designed that when the turbine blades spins due to the action of wind power, the vanes direct the air surrounded the turbine to chamber.

B. EXTRACTION NET

Since the Extraction nets are made up of hydrophilic polypropylene fibers which have the ability to trap the moisture present in the atmosphere, extraction nets also contribute in the condensation of the moisture in the air.

C. ALUMINIUM PIPE

Air get into the chamber through this pipe. This pipe is about 6ft long and is buried in the soil, where one end of the pipe is connected to the air inlet where the air enter into the pipe and the other end is connected to the storage chamber where the water get condense and stored. Since aluminum have more thermal conductivity it enable the air to reach the bottom while experiencing dew point temperature and gets condensed and dew droplets are formed along the walls of the metal pipe.

D. STORAGE TANK

Storage tank is buried down in the earth whose end is connected to the metal pipe, it have the capability to store 20 liters of water at a time.

E. DC MOTOR AND BELT DRIVE

During non-windy days the production of water can be less this can be overcome by using a dc motor of low voltage which is connected to the shaft of the turbine. Belt drive is used to transmit the power from the motor tom the shaft. The motor is either powered by using a solar battery system or a 6v rechargeable battery.

F. MISCELLANEOUS MATERIALS

DEW POINT TEMPERATURE CALCULATION

Definitions:

Dew-point temperature (Tdp) is defined as the temperature to which the air would have to cool (at constant pressure and constant water vapor content) in order to reach saturation.

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Dry-bulb temperature (DBT) is the temperature of air measured by a thermometer freely exposed to the outside air, but shielded from radiation and moisture.

Wet-bulb temperature (WBT is the lowest level of temperature that can be obtained through evaporative cooling of a ventilated surface covered with ice or wet with water.

Relative humidity (RH) is the amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature.

A well-known approximation used to calculate the dew point temperature, Tdp, is the Magnus formula*:*

$$(T,RH)= (RH/100) + bT/c+T$$

$$Tdp= [c\gamma\ (\ T,\ RH)]\ /\ [b- \gamma(T,RH)]$$

(Where, b = 17.67 & c = 243.5^{o}C and T is in ^{o}C).

Sample Calculations:

(For DBT=30^{o}C and RH=55%)

$(30, 55)=ln\ (55/100) + 17.67\times30/243.5+30=1.340$

$Tdp= [243.5\times1.340] / [17.67-1.139]$

=19.991

From this calculation we can easily find out dew point temperature at the different dry bulb Temperature as well as at different relative humidity.

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Dry Bulb Temp. (in he C)	Relative Humidity (%)	Required Dew point Temp. (in C)
30	45	16.777
30	55	19.991
30	65	22.713
30	75	23.938
30	85	25.090
30	95	29.111
30	100	30

Table: 1 Dew point temperature calculation at different dry bulb temperature and at different relative humidity

CONCLUSION

Our topic gives a clear picture about the concept of water extractor which can produce water from atmosphere. It can be used as a better alternative for atmospheric Water generator. This will make a great impact for people on present atmospheric conditions and diminishing water sources. Since our idea have both free and forced mode it can be used anywhere; having relative humidity above 50% preferable. This design is so simple that it fabricate to mankind.

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