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Atomshperic Water Extractor

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ABSTRACT

Water scarcity is one of the burning issues of today's world. Though water covers more than two third (about 70%) of the Earth's surface but still fresh water which can be used for drinking and carrying out everyday chores remains scarce (only about 2.5%). The acute problem of water shortage, is mainly faced by the countries with long coastlines and the island nations, which do not have adequate fresh water sources like rivers and ponds. As a result most of these countries meet their water demands by desalination of sea water which is a very costly affair. Also it may so happen that these desalination plants may fail which will cause acute water shortage. This is what just recently happened in Maldives. So there is an urgent need for countries like Maldives and others, who depend solely on desalination plants to meet their water requirements, to find alternative methods to generate water in order to meet their water security needs.

Such a device is called Atmospheric Water Extractor.

Keywords: Water Extractor,altranative methods to genarate water.

1.INTRODUCTION

In the summer of 2001, while working in an arid coastal region in the north-west of India (Kutch, Gujarat) on a project related to greenhouses, Girja Sharan (Innovator) observed incidentally that appreciable quantity of dew condensed on the roof of the cottage where he was staying. The occurrence of dew in summer appeared unusual to him. In his field work in Kutch, he had also noticed that the villages around the project area were chronically and severely short of drinking water. He recollected that in ancient Indian texts (some can be seen in Nature Social and water – website) dew drops were thought of as good water and wondered whether it was possible to build a device to harvest dew for ameliorating water shortage in these regions. The incidental observation and its linkage with drinking water shortage became the trigger points for the 'innovation journey' (Cheng and Van de Ven, 1996) of a new product, dew rain harvest system.

The innovator is an academician with graduate and doctoral degrees in agricultural engineering. He had been engaged in resolving field based technology issues in rural development. Between 2001 and 2005, the innovator, along with his team at Kutch, engineered dew condensers and built dew harvest systems for use of families and communities of Kutch region. Active commercialization began in 2006. The devices are actually termed 'dew rain' harvest systems because while these are specially engineered to harvest dew, rain is routinely harvested as well. The innovation has caught on. There are requests to build and install dew rain systems from NGOs, industries operating in coastal zone and individual farm owners. Dew rain harvest systems have potential in arid areas near coast - Saurashtra and Kutch coast, parts of Karnataka coast, parts of Orissa coast. A Church in Chennai coast has informed us that substantial amount of due occurred in the vicinity. The priest is interested in harvesting it for ameliorating the shortage of water. In the immediate neighbourhood of Kothara, there are 152 villages that do not have local source of drinking water and have to be supplied water by tankers on a regular basis. The supply is paid for by the public authorities. The system is unsatisfactory. Dew water will be a supplement and has the advantage - good quality, available right at the roof top of the individual. East and west coasts of Africa, Australia also are known to have the problem of drinking water and potential for dew harvest. (Clarke 1991).

2.LITERATURE SURVEY

Anbarasu and Pavithra (2011) Vapour compression refrigeration system, can be utilised to generate fresh drinking water by extracting water from humid ambient air by using Cooling Condensation process. In a cooling condensation based atmospheric water generator, a compressor circulates refrigerant through a condenser and an evaporator coil which cools the air surrounding it, lowering the air's temperature to that of dew point and causing water to condense. A controlled-speed fan pushes filtered air over the coil. The resulting water is then passed into a holding tank with purification and filtration system to keep the water pure. Atmospheric water generating technology offers 99.9% pure drinking water 365 days a year. The atmospheric water generator is an environmentally safe source of sustainable water. The water generator, made from air-conditioning and dehumidifier parts, can generate enough amount of water to meet the drinking water requirements of a regular household. It also addresses the need for safe drinking water in remote areas and

conducted, and the results from this experiment were used to validate the theoretical model. It was found that the theoretical prediction and experiment results match in the sense that both results shared the same trend. The experimental results show that the effectiveness of the heat exchanger increased from 67.9% to 72.4% with an increase of air face velocity. This co-generation system is considered as a green and cheap technology because it uses wasted energy and involves no moving parts."

responds to the impending scarcity of potable water in certain areas due to the effects of global warming and natural disasters. It can also replace or supplement the currently available water devices in the market to reach the more remote areas.

Niewenhuis et.al. (2012)A senior design project was aimed at designing and creating a prototype of an atmospheric water generator They have tried to incorporate Liquid Desiccant method to extract humidity from air and convert it into drinking water. Wet desiccation is a process where a brine solution is exposed to humid air in order to absorb water vapour from that air. The solution is then sent into a regenerator where the water vapour is extracted from the solution. This method has grown in popularity because of its efficiency and the ease with which it can be adapted to renewable energy, particularly solar. and others have also described a novel and unique method to extract water from air. They have said that it is possible to compress humid air so much that it will start condensing at the ambient temperature itself. As pressure increases the dew point rises; thus, enough compression will force the dew point above the ambient temperature resulting in spontaneous condensation. 10

But compressing air to extract water could potentially require pressures up to five times the ambient pressure. This will require a very sturdy tank that can handle high amounts of stress in its walls. This method has great potential for low energy demands, especially if one was able to recapture some of the energy in the compressed air using a turbine or piston. The energy efficiency of this design option has great promise but it is heavily dependent on compressor and decompressor efficiency and humidity. The primary advantage of pressure dehumidification is the low energy requirement; the only unavoidable loss is the pressure applied to the water vapour. However, any inefficiency in the compression/decompression cycle is amplified by the large volume of air processed per unit water produced. Additionally, the rate of production when driven by natural convection cooling to the atmosphere is too slow for significant production; some mechanism to speed up this heat transfer needs to be implemented, increasing the energy cost.

Kabeela et.al. (2014) In his paper "Solar-based atmospheric water generator utilisation of a fresh water recovery: A numerical study" has done thermodynamic analysis for a Peltier device which is used to develop a device that uses the principle of latent heat to convert molecules of water vapour into water droplets called the Atmospheric Water Generator. 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. Here, the goal is to obtain that specific temperature, called the dew point temperature, practically or experimentally to condense water from atmospheric humid air with the help of thermoelectric

Mr.Ajinkya Wankhade (2016) Pointed out that "In the atmoshpere contains a large quanity of water in the form of water vapour and this endless source odf water can be recoverd for genral drinking purpose.A new innovative method availble for extracting water from air is Absorption Refrigeration It is the clean source of energy and uses enviroment frinedlly refrigents.

Amount of water collected the system depends upon the atmoshperic condition like (DBT,DPT and RH) .

VCR based system woks only on eletricity supply where as in system the waste heat energy source can be changed according to the availablity.

Mr.Dhawal Khachane (2016) Mr Dhawal Khachane Presented a paper were air conditiong only;Wate heating +water cooling + air conditiong mode. The cop was 2.86 also oercentage reduction in power consumption highest at 24.06% on use of heat pump with multi utilies functions.The primary objective of this paper is to identify practically by expriment,efficient mode of opertion for multi utility heat pump.The operting modes

R.Vali & V Reddi (2016) R. Vali and V. Reddi [6] presented a research paper on experimental and performance investigation of

refrigeration system with helical geometry type condenser heat exchanger coil by using R-134a and R-410a refrigerants; objective of this research was to identify best coil geometry for efficient heat transfer in condenser. Primary objective is to develop helical coil, manufacture it and lab tests it with existing the

was encouraging to use R-410a than R-134a due to its superior properties viz. high refrigeration effect and thus better C.O.P. Comparison of this modified system with original system showed that performance of refrigerant Helical coil is better than old refrigerant

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3.OBJECTIVE

1. Study of the current available practices to extract atmospheric Water.
2. Prepare a cycle for condensation.
3. To develop setup for experiment.

4.METHODOLOGY

The work will be proposed to carry out in following phases –

Phase 1 – Data collection

Phase 2 – Analysis and selection of parts

a) Compressor
b) Condenser
c) Fine tube evaporator
d) Expansion valve
e) Receiver, Electric motor, Fan, Accumulator, Filter
f) Rotameter, Pressure gauge, Thermostat, Energy meter, Therm ocouple etc.

Phase 3 – Fabrication

Phase 4 – Testing

Phase 5 –Comparison of result

Phase 6 – Completion of dissertation and prepare dissertation Report.

5.EXPERIMENTAL WORK

1) Put the set up in proper position, where its level is horizontal and it is well ventilated.

2) The set up must have at least 1.5 meters empty space from all sides.

3) Give 230V, 50Hz and single phase power supply to unit.

4) Start the compressor by putting the main switch ON.

5) Record all readings as per observation table. Allow at least half hour running time for the system to get stabilized.

6.THEORETICAL WORK

1. Take various reading.
2. Calculate COP of the system.

7.EXPERIMENTAL SETUP

As per requriement we make a fabriaction for frame and mounting various compontes to ccomplete assembly Follwing fig shows the actual setup of our propsed project work.

Figure 1: Pictoral view of experimental setup for Atomshperic Water Extractor.

8.OBSERVATION

For testing of our project we take a various tests in moring session also evening session.

As per observation we known that in evening seesion humidity is high as comapre to afternoon session so water collection in evening is in large qty.

Reading taken on 18-03-2018

Testing on timimg7.40PM

Testing Complete timing 8.40PM

Below table shows the observation taking during working of system

Humidity	Suction Pressure	Discharge pressure	Time req for 10 pluse
70%	52 PSI	240PSI	12.73 Sec
Various Temperature Taken During working			
T1= 55.4		T2= 36.2	
T3= 06.0		T4= 21.1	

T5= 24.0	T6=13.0
T7=9.0	T8=7.7

9.CALCULATIONS

Our project setup is based on simple vapour compression cycle system.

So our calculation is same as simple vapour compression system.

All the formules is taken from Heat And Mass Transfer Book.

Water collected after 1Hour working **1** Liter

Sample Calculation of COP

Readings taken on 18/ 03/ 2018

From Observation table

P_C = 200 psi

P_E = 26 psi

Then, Pressure conversion is,

We know that, 1 bar = 14.5 psi

$P_C = \frac{200}{14.5}$ = 13.39 bar

$P_E = \frac{26}{14.5}$ = 1.79 bar

1) Input Power (I/p)

We know,

Energy meter constant = 3200 p / kwhr

Input power $= \frac{N \ X \ 3600}{EMC \ X \ Time}$

$= \frac{10 \ X3600}{3200 \ X \ 12.73}$

= 0.88374 kW

2) Output Power (o/p)

Output power = m x c_p x Δt

Where,

Q =Discharge of air

= Area of duct x Velocity

= 0.3556 X0.3556 X 0.44

= 0.0556 m^3/sec

m = mass of air

= Discharge x Density of air

= 0.556 X 1.2041

= 0.067 kg/sec

Output power = 0.067 x 1.005 x (13.0-7.7)

= 0.3568 kW

= 356.80 watt

3) Actual COP

$$(COP)_{act} = \frac{\text{Refrigeration Effect}}{\text{Compressor Work}} = \frac{R_h}{W_c}$$

= 356.80 / 883.74

= 0.4037

4) Theoretical COP

$$(COP)_{th} = \frac{H_{eo} - H_{ei}}{H_{ei} - H_{eo}}$$

$$= \frac{261.65 - 83.3}{275.57 - 261.65}$$

= 12.45

5) Carnot COP

$$(COP)_{Carnot} = \frac{T_H - T_L}{T_L}$$

Here,

T_L = -27 + 273= 246^{0}K

T_H = 36+273 = 309^{0}K

$$(COP)_{Carnot} = \frac{T_H - T_L}{T_L}$$

$$= \frac{309 - 246}{246}$$

= 0.2561

Various method to extract water from atmoshpre

a) Vapour Compression refrigenration system
b) Solar based atmospheric water extractor
c) Extraction water from air using adsorption refrigeration system
d) Waste heat recovery using heat pump
e) Using helical geometry type condencer heat exchanger coil method
f) Refrigeration system and peltier effect method

10. CONCLUSION

1.We have considered the humidity effects on water collection during night. High relative humidity will cause condensation on a relatively cold surface; because the thin layer of surrounding the surface cools below the dew point and can no longer hold the water vapour. Thus if relative humidity is more condensation will be more.

2.We have also considered effect of different time durations at night. It is observed that water collection during 7.00 pm to 12.00 am was uniform. And it increased during the period of 02.00 am to 06.00 am. For further durations up to 08.00 am it remained uniform.

3.Thus, we can conclude that, by using this setup on large scale, there can be considerable increase in water collection.

4.Atmospheric water vapour recovery for human need, not yet exploited on a large scale, could become a reality in the future. Although at present only small amounts of water are recovered. This can be easily achieved by our setup. This method is interesting because water could be obtained even in arid regions, including deserts.

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