OVER VIEW ON WATER GENERATION FROM ATMOSPHERIC AIR

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Abstract: ***Water vapour in the air can be extracted by condensation - cooling the air below its dew point, exposing the air to desiccants, or pressurizing the air. Unlike a dehumidifier, an ATMOSPHERIC WATER GENERATOR(AWG) is designed to render the water potable. AWGs are useful where pure drinking water is difficult or impossible to obtain, because there is almost always a small amount of water in the air that can be extracted. The two primary techniques in use are cooling and desiccants. Many atmospheric water generators operate in a manner very similar to that of a dehumidifier: air is moved over a cooled coil, causing water to condense. The rate of water production depends on the ambient temperature, humidity, the volume of air passing over the coil, and the machine's capacity to cool the coil. These systems shrinkage air temperature, which in turn reduces the air's capacity to carry water vapour.***

Key words: ***Copper tube, Cooling fan, Heat sink, Peltier module***

1. INTRODUCTION

The Atmosphere contains water in the form of water vapour, moisture etc. Within that amount almost 35% of the water is wasted. This amount of water can be used with the help of a Atmospheric Water Generator. This device can convert atmospheric moisture directly into usable and even drinking water. 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. So, this project will be helping to extend the applications of such devices further soon. According to previous knowledge, we know that the temperature requires to condense water is known as dew point temperature. Here, the goal is to obtain that specific temperature practically or experimentally to condense water with the help of some electronics devices. This project consists of a bicycle-gear arrangement for running a condenser 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 various uses. Looking into one of the most prominent concerns in the developing and underdeveloped world, water crisis is one of the main problems that still persists since it is one of the most essential, basic and important requirements for a healthy body and the availability of clean water is really scare in these areas.

In order to rectify and reduce these persistent problems related to water availability, especially in the coastal districts, where the sea is accessible but no means of cleaning that water for a good use.

In this regard, our team will be working on in developing a water generator which will condense the suspended water molecules (humidity) from the atmosphere into liquid phase water. But, in order for this project to catch up, it must be applicable in the regions like the Eastern Province in the coastal cities where the humidity conditions can rise up to as much as 60% in the atmosphere during peak times. This water generated could be then used in various applications.

1.1 *Peltier Module*

Thermoelectric coolers operate according to the Peltier effect. The effect creates a temperature difference by transferring heat between two electrical junctions. A voltage is applied across joined conductors to create an electric current. When the current flows through the junctions of the two conductors, heat is removed at one junction and cooling occurs. Heat is deposited at the other junction. The main application of the Peltier effect is cooling. However, the Peltier effect can also be used for heating or control of temperature. In every case, a DC voltage is required.

1.2 *Heat Sink*

A heat sink is a component that increases the heat flow away from a hot device. It accomplishes this task by increasing the device's working surface area and the amount of low-temperature fluid that moves across its enlarged surface area.

2. LITERATURE REVIEW

Vapour compression refrigeration system, can be utilized 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.

A senior design project was aimed at designing and creating a prototype of an atmospheric water generator (Niewenhuis et.al. 2012). They have tried to incorporate Liquid Desiccant method to extract humidity from air and convert it into drinking water.

(Kabeela et.al. 2014) In his paper "Solar-based atmospheric water generator utilization 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.

3. PROPOSED DESIGN

The moisture content in the atmosphere is extracted with the help of the Suction fan close at the top of the device. The suction fan is placed above the cooling coil so as to help the air moisture to be spread across the coil. There is a tank to collect water and the compressor, condenser and condenser fan are in between. There is a helical capillary expansion which is used to change the temperature. The isolation of the setup was done with thermocol to increase the efficiency. The cooling coil is where the vapors are condensed above which has a bimetallic sensor which helps in switching of the compressor at a particular temperature. The capillary tube is acts like an expansion valve where the temperature changes from the output to the input. The heat given out from the condenser is been converted to coldness as this part. The compressor which works with the fluid motion inside pumps the R134-A (Tetrafluoro ethane) gas into the cooling coil which helps us frost the atmospheric moisture from which the water is collected. Frost is formed in the coil, after which the compressor is switched off and the heater coil is activated. Hence melting takes place and water droplets were obtained. This was then collected into a major tank.

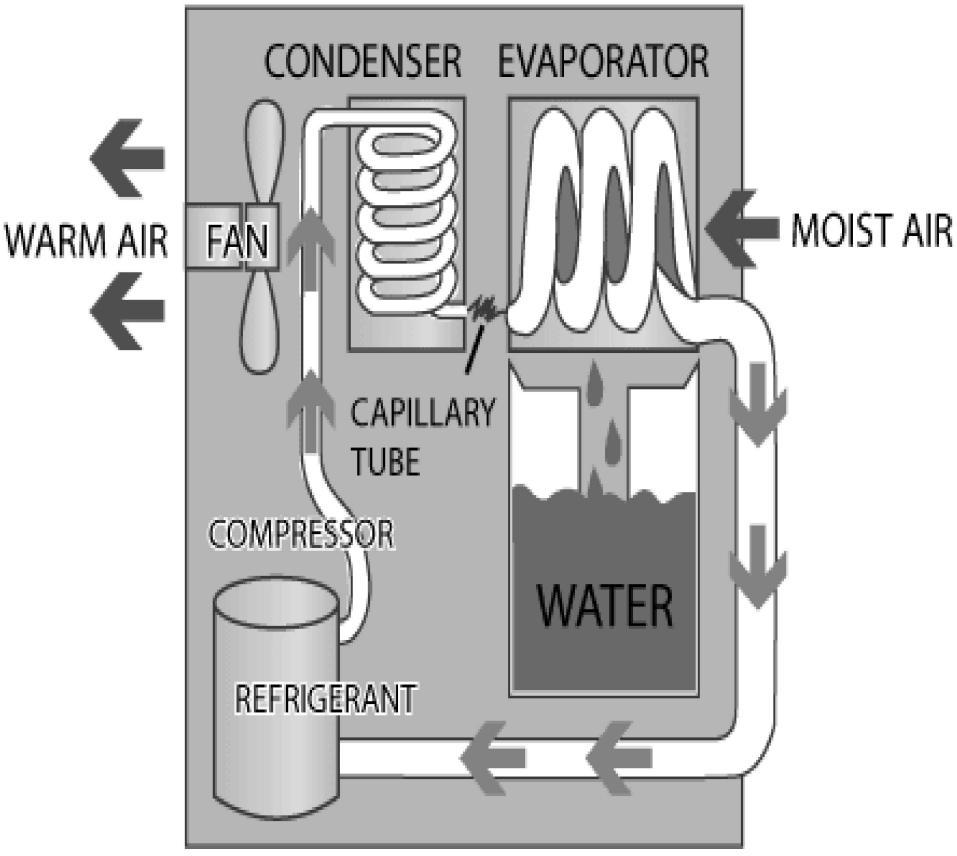

Figure 1: ***Block diagram of dehumidification process***

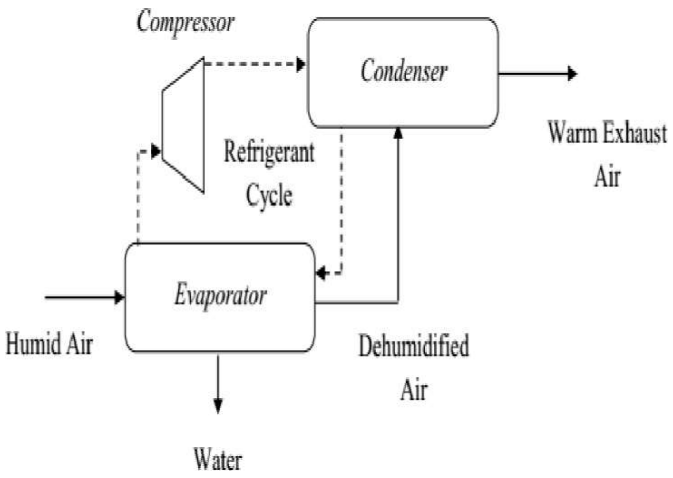

Figure 2: ***Dehumidification by Refrigeration cycle***

4. COST ANALYSIS

A proposed cost analysis has been prepared based on the component used in this Water Generation process through Atmospheric air. The list is given below.

SL.NO	COMPONENTS	COST IN RUPEES
1.	PELTIER MODULE + PVC PIPE	600
2.	DC WATER PUMP	400
3.	12V ADAPTER	400
4.	COOLING FAN+HEAT SINK+ WATER COOLING BLOCK+ COPPER TUBE	1000
	TOTAL COST	2400

5. APPLICATIONS

Atmospheric water generators are primarily being used in industries and commercial building owing to high installations costs. High electricity consumption coupled with high capital cost has been a limitation of AWG market growth especially in the residential segment.

i) However, increasing production of solar and wind energy based atmospheric water generators is expected to open new avenues in the global industry over the coming years.

ii) Metal organic framework (MOFs) based atmospheric water generators and sun-to-water devices have been a few of the recent technological breakthroughs in the global AWG industry. Atmospheric water sources constitute nearly 10% of fresh water on Earth. The technology of water extraction from atmospheric air is still at an early stage compared with other systems such as water distillation. However, if the experience of the studies carried out in desiccant cooling is applied in this area, improved and more efficient units could be designed.

5. CONCLUSION AND FUTURE SCOPE

The heat exchanger hot fluid is always higher than the exit temperature of the cold fluid. In counter-current flow configuration, the exit temperature of the hot fluid is also higher than the exit temperature of the cold fluid. However, in counter current flow configuration, the exit temperature of the cold fluid is higher than the exit temperature of the cold fluid in co-current configuration. Hence, for heat exchanger, counter current flow configuration has a higher effectiveness than the co-current flow formation. The experiment shows that when the flow rate of one of the stream increases, the rate of heat transfer will also increase. The amount of heat loss forms the hot water is not equal to the heat gain by the cold water due to the heat loss to the surrounding. From the calculations done, the LMTD (log mean temperature difference) for co current flow is higher than the counter- current flow is higher than the co-current flow. As a conclusion, counter current flow configuration of heat exchanger is more preferred for practical application. One of the applications of heat exchanger is oil cooler. One of which is, to properly optimize the system which facilitate the production of water in case of conditions where humidity can be decreased too low. Secondly, there should also be a need to properly insulate the heat sink to avoid leakage of current and heat which will eventually improve the efficiency of the whole system. Also, there would be a need of heat sink wall modification to avoid resting on it and instead is passed straight towards the water container.

REFERENCES

1. Niewenhuis B., Shepperly C., Beek R.V., Kooten E.V. “Water generator water from air using liquid desiccant method”, 2012

2. Kabeela A.E, Abdulazizb M., Emad M.S. “Solar-based atmospheric water generator utilisation of a fresh water recovery: A numerical study”, 2014

3. Vishal Tambat, Nilkanth Rane, Omkar Savant, 4Pankaj Yadav. Pneumatic Shearing and bending Machine, IJRRCME, Vol. 2, Issue 1, pp: (9-18), Month: April 2015 – September 2015.

4. Madhu Kumar V ― Design and Fabrication of Pneumatic Sheet Metal Cutting and Bending machine. International Journal of Engineering Research And Advanced Technology (IJERAT).

5. Aniruddha Kulkarni, Mangesh Pawar ―Sheet Metal Bending Machine. IJIERT, I SSN: 2394-3696 VOLUME 2, ISSUE 3, March.-2015

6. Patil Rohit R, Jadhav Amol K . Hydraulic Rebar Cutter, International Journal of Current engineering and Technology, E-ISSN 2277 –4106, P-ISSN 2347 –5161.

7. Aniruddha Kulkarni, Mangesh Pawar ―Methodology Of Special Purpose Sheet Metal cutting Machine. IJPRET, ISSN: 2319-507X, VOLUME 2, ISSUE 9, 2014.

8. Patil Rohit R, Jadhav Amol K . Analysis and Simulation of Sheet Metal Cutting By Using radan Software, IJIR,, Vol-2, Issue-5, 2016 ISSN: 2454-1362.