Atmospheric Water Generator

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Abstract- *World essentially needs alternative "water regeneration" methods and producing water from air is one of the most viable and sound solutions presented as the world's fresh water needs increase daily. The lack of inexpensive, drinkable water for people around the globe is becoming a very serious problem and recent published stories address the concerns from scientists around the world .This technology has ability to meet and fill the growing demand for economical, safe, great tasting drinking water. We have designed and developed a prototype system for removing clean (portable) drinking water from air using a traditional power grid. Use a traditional power grid to generate electricity; use electricity to cool air (or increase pressure) resulting in condensation of water; capture water vapor from air that condenses into water to obtain 99% pure and safe drinking water from the moisture in the air.*

Implementation of process using most efficient and cost effective method is also an important concern in project.

Keywords- regeneration; inexpensive; potable.

I. INTRODUCTION

An atmospheric water generator is a device that extracts water from humid ambient air. Water vapour in the air is condensed by cooling the air below its dew point, exposing the air to desiccants, or pressurizing the air. Where pure drinking water is difficult or impossible to obtain AWGs are very useful in locations, as the air contains always a small amount of water. The two primary techniques in use are cooling water vapor and using desiccants. In the initial stage we are trying to obtain one to two liters of water in 1 hours with relative humidity of 70%.Within this period, it consumed 0.5 kilowatt-hours of energy per 500 of water generated. Atmospheric water generator technologies can address the need for clean water without any health or environment concerns. They are already available in locations that have grid power and public waterworks.

II. WORKING PRINCIPLE

In a cooling atmospheric water generator, a compressor circulates refrigerant through a condenser and then an evaporator coil which cools the air surrounding it. This lowers the air temperature to its dew point, 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 help keep the water pure and reduce the risk posed by viruses and bacteria which may be collected from the ambient air on the evaporator coil by the condensing water. The rate at which water can be produced depends on relative humidity and ambient air temperature and size of the compressor. Atmospheric water generators become more effective as relative humidity and air temperature increase.As a rule of thumb, cooling condensation atmospheric water generators do not work efficiently when the temperature falls below 18.3°C (65°F) or the relative humidity drops below 30%. This means they are relatively inefficient when located inside air-conditioned offices. The cost-effectiveness of an AWG depends on the capacity of the machine, local humidity and temperature conditions and the cost to power the unit.Water is often condensed from the air in the air conditioners when the ambient air is humid and hot in coastal tropical regions. This water can be conveniently used for drinking purpose.First, confirm that you have the correct template for your paper size. This template has been tailored for output on the A4 paper size. If you are using US letter-sized paper, please close this file and download the file "MSW_USltr_format".

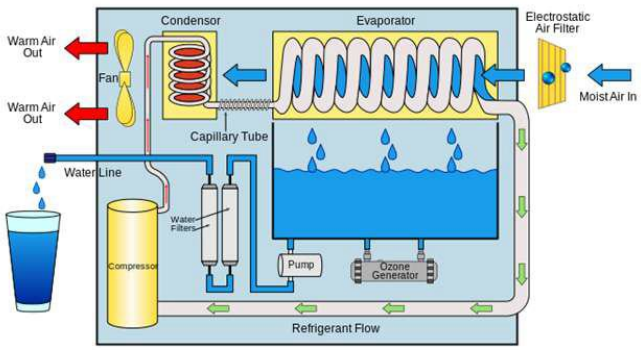

Fig 1: Schematic diagram of the system

III. COMPONENTS OF PROJECT

1. COMPRESSOR**:**

An **air compressor** is a device that converts power (using an electric motor, diesel or gasoline engine, etc.)into

potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.

2. CONDENSOR:

In systems involving heat transfer, a **condenser** is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. In so doing, the latent heat is given up by the substance, and will transfer to the condenser coolant. Condensers are typically heat exchangers which have various designs and come in many sizes ranging from rather small (hand-held) to very large industrial-scale units used in plant processes.

3. BATTERY:

An electric **battery** is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices.

IV. SCOPE AND OBJECTIVES

[1] Flexibility in Power Source - The design should be able to utilize a variety of power sources, including (but notlimited to) solar, wind, and the traditional power grid.
[2] 1 Litre of Water Production per Day - The design should produce at least one litre of drinkable water per day.
[3] Maximize Efficiency - The design should maximize the water produced per unit energy.
[4] Minimize Maintenance - The system should be designed for long-term operation, requiring only low cost and minimally intensive repairs.
[5] Minimize Cost - The design should minimize the cost per unit water production.
[6] The project can be implemented in the areas where the humidity is above 40% throughout the year.

V. BASIC LAWS AND DEFINITIONS

[1] Energy can neither be created nor can be destroyed. It can be only converted from one form to another. Thus total amount of energy in the universe remains constant.
[2] Heat always flows from the material at higher to the material at lower temperature.
[3] Saturation Vapour Pressure
Amount of water vapour that air can hold at given temperature is saturation vapour pressure OR Maximum amount of water vapour that air can hold.
[4] Vapour Pressure
Actual amount of water vapour in the air is vapour pressure.
[5] Dew Point
It is temperature at which relative humidity reaches 100%. At this point air is so full of moisture that it cannot hold any more water.

A. Equations

1. Formula for obtaining maximum amount of water absorbed using desiccants.

$$\text{Water Absorbed} = \frac{\text{Start\%}}{\text{End\%}} - 1$$

Where,
Water absorbed = water absorbed per pound of CaCl2.
Start% = starting concentration of CaCl2.
End% = ending concentration of CaCl2.

2.Coefficient of Performance in Refrigeration cycle is given by

$$\text{COP} = \frac{\text{Temp}_{evap}}{\text{Temp}_{cond} - \text{Temp}_{evap}}$$

COP= Coefficient of performance.
Temp evap=Temperature of Evaporator.
Temp cond= Temperature of Condensor.

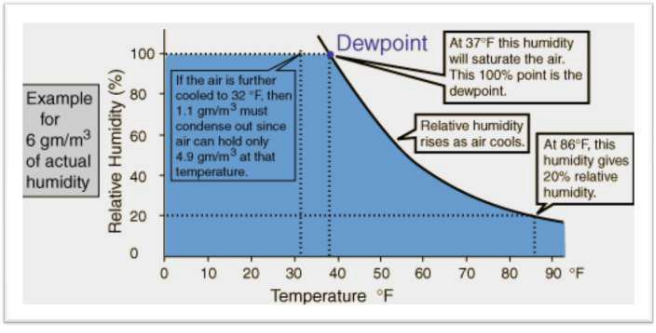

Fig 2: Dew point temperature

B. Calculations:

This calculation forms an important part of this project as this helps us to determine at temperature the device must be maintained in order to condense the humidity present inair at the given atmospheric condition.

$$\gamma(T,RH) = \ln\left(\frac{RH}{100}\right) + \frac{bT}{c+T}$$

$$T_{dp} = \frac{c\gamma\ (T,RH)}{b - \gamma(T,RH)}$$

The table for the dew point temperature calculation for different atmospheric conditions is as follows:

Temp (in C)	Relative Humidity	Required Dew Point Temp (in C)
30	55	18.5
30	70	23.9
35	55	24.7
35	70	28.7
40	55	34.1
40	65	37.2
40	75	39.6

V. MATERIAL SELECTION

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. Following are the component's materials used

SR.NO	NAME OF THE COMPONENT	MATERIAL
1	compressor	
2	Condensed tubes	Copper
3	Nut bolts	Mild steel
4	Angles	M.S.
5	Strips	M.S.
5	Capillary tube	Stainless steel
6	Copper tubes	copper
7	Evaporator	copper
8	Frame	Mild steel
9	Water collecting tank	S.S

VI. REFRIGERANT

A liquid which absorbs heat from low temperature body and rejects the same to high temperature either in the form of sensible and or latent heat. Refrigerants are mainly classified into two groups Primary refrigerant and Secondary refrigerant

Primary refrigerant directly take part in refrigeration system for example- household refrigerator, where as secondary refrigerant are first cooled with the help of primary refrigerant and are further used for cooling purpose for example Ice plant.

VII. APPLICATIONS

There are hardly any chances to refuse that this device is portable for its simple design and endurance capability. So, the Atmospheric Water Generator is the device which can be implemented for extreme situation, to use during flood, in desert areas, and in rural areas. It has great advantages as it works like a renewable source of atmosphere water and doesn't need a heavy power source. Many company like 'Watermaker India ltd', 'Aerowater', etc. have already this type of device for domestic purpose. It can be implemented for Industrial development where the water is a matter of crisis.

VIII. FUTURE SCOPE

Every machine has scope for its future modification for gaining more and more beneficial out put with the least input. Hence human is always trying to achieving it. The technology comes under the research and development activity. Our product being the small and compact one, still it has so many scopes for it's future developments as following:-

1. We can install container sensor such that whenever the pot comes under the tap it opens and drops the water
2. The water level indicator can be installed so that the level of water can be easily detected and maintained.
3. The body material can be replaced by stainless steel to save it from the environmental corrosion and erosion.

IX. CONCLUSION

In the initial stage we have successfully obtained 500-1 litre of water in 1 hour with relative humidity of 70% Within this period, it consumed 0.5 kilowatt-hours of energy per 500 ml of water generated using refrigeration process. Our aim would be extracting humidity from the air and then purifying it into the highest quality drinking water by sending the collected condensation through a series of ultra-high quality filters that kills all germs, bacteria and viruses that could be present in the water. The end result is the cleanest, purest water. The water is absolutely pure, safe and clean, as well as great tasting.

X. PROJECT SIGNIFICANCE

- It can help solve the problem of water scarcity.
- It works via bicycle-gear arrangement rather than relying on conventional source.
- It is portable and can be used almost anywhere.
- It saves money in terms of electricity consumption and also is a more viable option than ordering a water tank from the municipal corporation.

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