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OVERVIEW ON ATMOSPHERIC WATER GENERATION TECHNOLOGIES

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ABSTRACT

Atmospheric water generation (AWG) is a new invention technology that uses a thermoelectric device to collect water from wet air. The current research focuses on how water is extracted from atmospheric air and how it is extracted. According to our findings, water can be produced from very moist air at a moderate atmospheric temperature. This is especially useful during times of deficiency or tainting. It can also be used in areas near the sea or in the desert, as well as in other situations where drinking water systems are disrupted. When public water infrastructure fails as a result of natural disasters such as earthquakes and cyclones, the usage of AWG technology as an emergency and long-term solution has expanded.

Keywords: Atmospheric Water Generator, Peltier Effect, Thermo-Electric Cooling, Solar Energy, Water Condensation.

I. INTRODUCTION

Water for drinking, irrigation, and other reasons is difficult to come by in most countries, especially in desert regions and areas without access to electricity or fuel. Due to a lack of rainfall, water shortage has become a major problem in many parts of the world. Water can be obtained by condensing the water vapour present in the air in such places as those near the sea.

A mechanism that converts humid air into water is generated by atmospheric water. This is accomplished by using coldness and chilling the air. Due to a lack of rainfall in humid areas such as the desert and the sea, we can acquire water by condensing water vapour in the air. This device transforms the moisture in the air into a liquid. By condensing the heat that transforms water vapour into water droplets; this gadget converts ambient moisture directly into fresh water. As a thermoelectric device, the Peltier module is employed. The gadget operates on the idea of converting heat into water vapour molecules, which are subsequently transformed into water droplets. Many parts in India, such as the desert, rain forest areas, and even flooded areas, have extremely high atmospheric humidity. However, water resources are scarce. We can reduce compressor and condenser usage in this project by employing a Peltier device. As a result, we can lower the equipment's space and size.

II. LATEST TECHNIQUE AND WORKING PRINCIPLE

2.1 Dehumidification Techniques:

When we study about the atmospheric water generation the first step is to analyze different methods of dehumidification. In this study we try to use this water from the environment and use it for drinking. Three common psychometric technique of dehumidification used during preliminary research; a temperature reduce below the temperature of refrigeration condenser, pressure condensing, or a mixture of the both.

2.1.1 Dehumidification by Refrigeration: Conventional refrigeration dehumidification cycleis the one of the most common technique for generating water from moist air. This method air is circulates over cooling coils which connected during a refrigeration cycle to bring the water from the air below its temperature. The temperature of the water depends on the vapour pressure and humidity and tends to be a comparatively cold compared to the ambient conditions. To reach the temperature the air running through the unit will need to be cooled a substantial amount. This process is shown in Figure 1 below

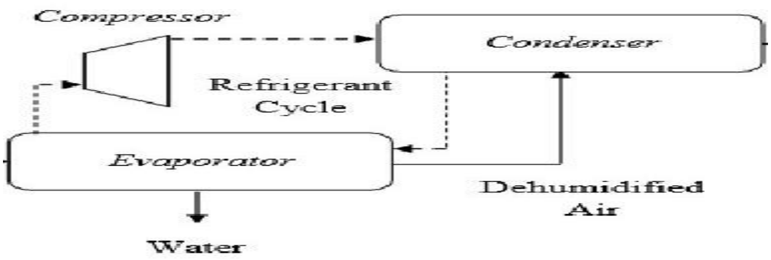

Figure 1: Dehumidification by Refrigeration cycle

2.2. Vapour Compression Method

Vapour pressure refrigeration in air conditioners is another extensively utilised cooling method. The heat is evacuated from the space by employing a liquid refrigerant that is cooled and circulated through vapour compression. A single-stage vapour-compression system is shown in Figure 2. A blower, a condenser, a heated extension valve, and an evaporator are the four main components of the system. In the compressor, circulating refrigerant enters as saturated vapour and is compressed [1]. As a result, there is a lot of pressure, which leads to a lot of heat. When compressed air is converted into superheated air and reaches the desired temperature and pressure, condensation is complete. Condensation can occur with the help of cooling water or cool air. The hot vapour is cooled and condensed as it passes through a condenser. This is where the system's circulating refrigerant rejects heat. The condensed liquid refrigerant then travels through an expansion valve, which causes a pressure drop. Diffusive glare evaporation of the liquid refrigerant occurs as a result of this. The Joule-Thomson effect [2] reduces the temperature of the liquid-vapor refrigerant mixture, making it colder than the desired temperature (temperature of the encased space.)

The cold mixture is passed through the evaporator's coils. The heated air in the closed space is circulated by a fan across the coils that carry the cold refrigerant liquid and vapour mixture. That warm air evaporates the liquid from the cold refrigerant while simultaneously cooling the circulating air, lowering the temperature of the enclosed chamber. The flowing refrigerant absorbs and removes heat from the evaporator, which is subsequently rejected and transferred by the condenser's water or air. The refrigerant vapour beginning of the evaporator, which is again a saturated vapour, is returned to the compressor for the remainder of the refrigeration cycle.

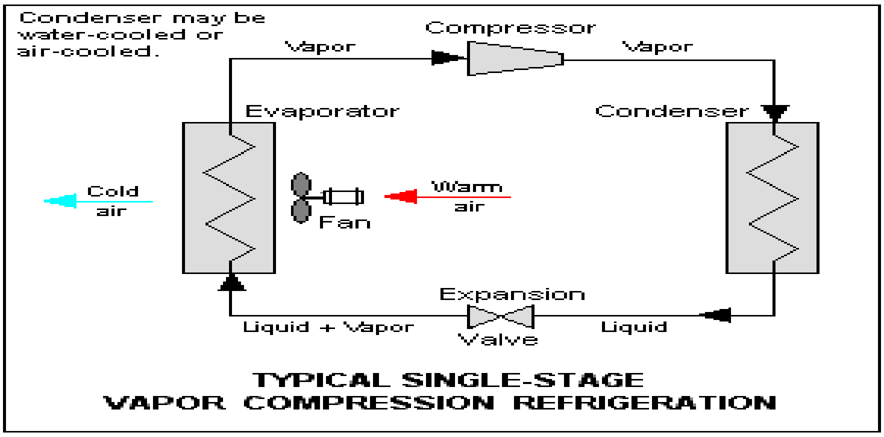

Figure 2: Vapour Compression Refrigeration cycle

2.2.1 Thermodynamic analysis of the system

Figure 3 shows a temperature versus entropy curve that is used to study the thermodynamics of the vapour compression cycle. The circulating refrigerant acts as a saturated vapour in the compressor at point 1, as indicated in Figure 3. Figure 3 shows the refrigerant circulating at constant entropy from point 1 to point 2, and it was discharged from the compressor as superheated vapour.

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Between points 2 and 3, where the vapour flows through the condenser and the superheat is removed, the cooling process of the vapour is finished. From point 3 to point 4, the vapour condenses into a saturated liquid and exits the condenser. This procedure is carried out under continual pressure.

There is a significant drop in pressure as the saturated liquid refrigerant travels through the expansion valve from point 4 to 5. The Joule Thomson effect is the phenomenon that causes adiabatic flash evaporation and auto-refrigeration for particular liquids. At constant enthalpy, the adiabatic flash evaporation process takes place. From point 5 to 1, the partially vaporised cold refrigerant travels through the coils within the evaporator, where it is completely vaporised by partially hot air circulated with the help of the evaporator's fan. By superheating the liquid and vapour mixture, the evaporator boils liquid.By superheating the liquid and vapour mixture of refrigerant under constant pressure, the evaporator boils liquid (isobaric). Finally, the resulting refrigerants vapour flows back to point 1 of the thermodynamic cycle, completing the thermodynamic cycle.

A complete vapour compression refrigeration cycle is depicted in the diagram above.

2.2.2 Refrigerant

To reduce the ozone layer depletion there's a gradual shift from the CFCs to the HCFCs because CFCs which is one of the foremost crucial item of a vapour compression cooling system. Now a day's many research is being ongoing to show environment friendly refrigerants, supercritical CO2 referred to as R-744 [3] being one among them, which have same efficiencies as compared to existing CFC and HFC based refrigerants, and have to reduce the global warming effects.

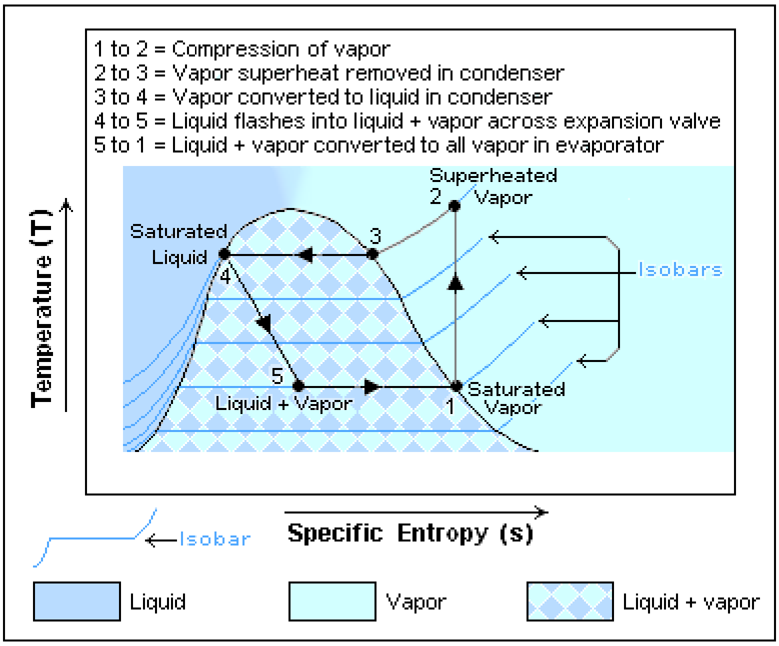

Figure 3: T-S plot of vapour compression refrigeration cycle

2.2.3 Sorts of gas compressors

Reciprocating, rotary screw, centrifugal, and scroll compressors are among the numerous types of compressors utilized. Based on their size, noise, efficiency, and pressure ratings, each of these varieties has a specific purpose. There are three types of compressors in general. Depending on the location of the compressor and/or motor in relation to the refrigerant being compressed, they are open, closed, or semi-closed. It's possible that the following setups are available:

- closed motor + closed compressor
- closed motor + semi-closed compressor
- Open motor (belt driven or close coupled) + closed compressor
- Open motor (belt driven or close coupled) + semi- closed compressor

The compressor and the motor that drives it are usually connected in closed and semi-closed compressors. The compressor compresses the refrigerant, which cools the motor. The motor's biggest disadvantage is that it is

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integrated into the compressor, and therefore cannot be removed and fixed if it fails. Furthermore, burned-out windings may cause the entire refrigeration system to fail, necessitating a pump-down and refrigerant replacement [4].

The motor drive for an open compressor is located outside of the refrigeration system, and an input shaft is utilised to drive the compressor, which is sealed with gland seals. These open compressor motors are usually air-cooled and may be easily replaced or repaired without causing any disruption to the refrigeration system. The main disadvantage of this compressor type is the loss of refrigerant due to gland seal failure. Open motor compressors are better suitable in situations where gas temperatures are occasionally quite high due to their simple design and easy cooling.

III. MATERIALS AND TECHNIQUE

3.1 Components used:

Sr. No.	Part Name	Qty.	Unit Of The Part.
1	Compressor	1	Nos.
2	Condenser	1	Nos.
3	Evaporator	1	Nos.
4	Absorb Fan	2	Nos.
5	Copper Pipe	8	Feet.
6	Filter	1	Nos.
7	Capillary Tube	3	Meter
9	Refrigrent R-134a	4	Bottles
10	Steel Frame	17(Aprox.)	Feet.
11	Valve	2	Nos.
12	Harvesting Top	1	Nos.
13	Storage Tank	1	Nos.
14	Capacitor	1	Nos.

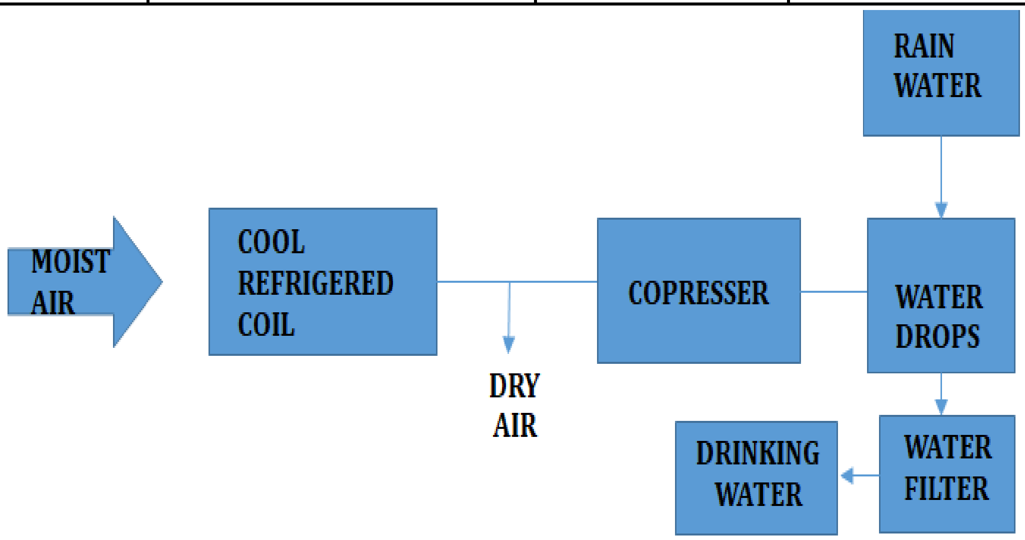

Figure 4: Working Flow chart of AWG

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3.2 OPERATION

A compressor circulates refrigerant through a condenser in an atmospheric water generator, while an evaporator coil cools the air around it. This cools the air to its original temperature, causing water to condense. Filtered air is pushed over the coil by a fan with a variable speed. The condensing water is then fed into a tank with a purification and filtering system to maintain the water pure and reduce contamination by viruses and bacteria that can be gathered from the ambient air on the evaporator coil. The amount of water produced is mostly determined by the ratio, ambient air temperature, relative humidity, and compressor size. As the ratio and air temperature rise, atmospheric water generators get easier. When the temperature goes below 18.3°C (65°F) or the ratio falls below 30%, cooling condensation atmospheric water generators will not perform efficiently. An AWG's cost-effectiveness ration is determined by the machine's capacity, local humidity and temperature conditions, and thus the cost of powering the unit. When the ambient air is humid and warm in coastal tropical climates, water condenses from the air within the air conditioners. This water is utilized to make pure drinking water.

3.3 HUMIDITY AND TEMPERATURE RELATION

The amount of water vapour is required to saturate the air. The ratio may be a percent of saturation humidity, generally calculated in reference to saturation vapour density. The ratio is expressed as a percentage, therefore the maximum is 100%. The formula for relative humidity is:

Relative humidity % =Moisture within the air now / Maximum possible moisture air can hold at the present temperature (x100)

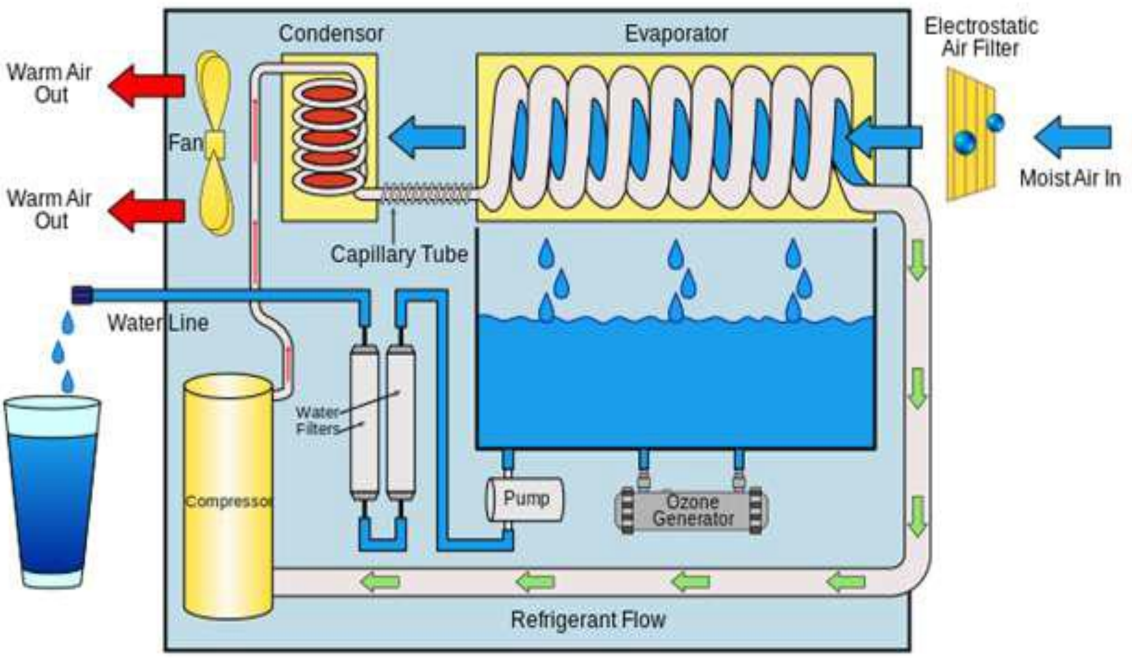

Fig 5: Conventional Atmospheric Water Generator

3.3 PROJECT SIGNIFICANCE

- AWG has the ability to tackle the problem of water scarcity.
- The AWG is a bicycle-gear setup that is portable and can be used anywhere.
- AWG saves money by lowering electricity usage and offers water at a low cost.

3.4 APPLICATIONS

The Atmospheric Water Generator is small in size, has a basic construction, and has a lot of power. As a result, the Atmospheric Water Generator is a technology that may be used in a variety of extreme situations, including floods, desert locations, and rural places. It has numerous advantages because it uses a renewable source of atmospheric water and does not require a significant amount of power. It can be employed in areas where water is a major issue for industrial development.

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IV. CONCLUSION

The cold mixture is passed through the evaporator's coils. The heated air in the closed space is circulated by a fan across the coils that carry the cold refrigerant liquid and vapour mixture. That warm air evaporates the liquid from the cold refrigerant while simultaneously cooling the circulating air, lowering the temperature of the enclosed chamber. The flowing refrigerant absorbs and removes heat from the evaporator, which is subsequently rejected and transferred by the condenser's water or air. The refrigerant vapour beginning of the evaporator, which is again a saturated vapour, is returned to the c for the remainder of the refrigeration cycle. sources. Similarly, it contributes to the difficulty of obtaining non-contaminated water in isolated areas, mining sites, and other areas where water is scarce.

V. REFERENCES

[1] Scott, C.; Sugg, Z., Global energy development and climate-induced water scarcity—Physical limits, sectoral constraints, and policy imperatives. Energies 2015, 8, (8), 8211-8225.

[2] Mekonnen, M. M.; Hoekstra, A. Y., Four billion people facing severe water scarcity. Science Advances 2016, 2, (2), e1500323.

[3] Wang, S.; Wang, S., Implications of improving energy efficiency for water resources. Energy 2017, 140, 922-928.

[4] Narayan, G. P.; Sharqawy, M. H.; Summers, E. K.; Lienhard, J. H.; Zubair, S. M.; Antar, M. A., The potential of solar-driven humidification–dehumidification desalination for small-scale decentralized water production. Renewable and Sustainable Energy Reviews 14, (4), 1187-1201.

[5] Zhao, D.; Tan, G., A review of thermoelectric cooling: Materials, modeling and applications. Applied Thermal Engineering 2014, 66, (1-2), 15-24.

[6] Lv, S.; He, W.; Wang, L.; Li, G.; Ji, J.; Chen, H.; Zhang, G., Design, fabrication and feasibility analysis of a thermo-electric wearable helmet. Applied Thermal Engineering 2016, 109, 138-146.

[7] Vasant, P.; Kose, U.; Watada, J., Metaheuristic Techniques in Enhancing the Efficiency and Performance of Thermo-Electric Cooling Devices. Energies 2017, 10, (11), 50.