Water Generation From Environmental Air With The Help of Vapour Compression Refrigeration System

Giriraj Kishore Singh[1], Gulshan Singh[2], Gautam Ranjan[3], A.H. Khan[4], Ashish Chaturvedi[5], Saumitra Sharma[6]

[1,2,3]Student of 8th Sem, [4]HOD, [5,6]Asst. Professor

Department of Mechanical Engineering, Oriental College of Technology, Bhopal, INDIA

Abstract – The lack of clean drinking water is one of the key issues facing the world today. The water in many countries is of poor quality creating a big demand for bottled water where the economic means are available. For underdeveloped countries this has led to the death of millions while it in the industrialized world has meant a big increase in consumption of bottled water which has had a big negative effect on the environment. There have been some efforts in trying to develop an applicable technology as a solution to the water problem. One line of products in particular has been influential for this project. These products are known as atmospheric water generators and are trying to utilize the natural occurrence of water vapor in air in order to produce clean drinking water.

Keywords – Relative Humidity, Specific Humidity, Dry Bulb Temperature, Dew Point Temperature.

1. INTRODUCTION

Because of pure water scarcity in many regions worldwide, finding alternative methods for pure water generation becomes beneficial enough to motivate many researchers to work on related topics. Atmospheric water generation is one of the promising methods for getting pure water. Atmospheric water generators (AWGs) apply vapour compression refrigeration to extract water vapour from the surrounding air. They produce drinking quality water and they require moist air and electricity. 2. Purpose This thesis is a part of the development of an AWG, for this purpose the project group will initially investigate the suitability of the vapor compression cycle, where the extraction will be obtained on the evaporator. An AWG is a device that generates clean drinking water by utilizing the natural presence of water vapor in the air. This thesis will hopefully result in information that will be used as a basic data for decision-making. Since most of the evaporators on the market today are designed merely to cool the air passing through them, much effort will be made to design an evaporator that not only lower the temperature but also condensate some of the water vapor included in the air and to collect the condensed water if this technology is assessed to be liable. There can also be other technologies that can be more suitable for this application. The main purpose is to investigate which technology is the most suitable one in order to extract water. Other possible solutions for this problem will be presented, explained and discussed. The purpose is to find and develop a technology applicable for water extraction

3. Problem The main objective of this project is to create a product that is able to produce safe and clean drinking water while only consuming air and energy. The problem of this thesis concerns the nature, technology and process of the actual extraction. This report will try to answer how the actual extraction will be performed, what technology will be used and why.

Background:

Bottled water is the fastest growing beverage market both in India and worldwide. Growth in this market has been accompanied by an increase in concerns about the environmental impact of bottled water. This focus on the environmental impact of bottled water has created a new marketing niche whereby promoters of other water products now seek advantage by promoting themselves as environmentally friendly [30:164].

It has been addressing that the need to provide pure drinking water for the past two decades. The objective of the project is to design and develop a new extractor of water that is able to produce water daily in various climate conditions, and can deliver water in conditions less relative humidity. The machine should produce great-tasting water and be energy efficient with an implemented alternative power source for energy conservation. The product should also be portable.

Objectives of the project:

- Earth's atmosphere contains billion cubic meters of fresh water, which is considerable as a reliable water resource, especially in sultry areas.
- Earth's surface contains billion cubic of fresh water which is considerable as fresh water.
- Water is to be purified.
- Available of water to drinking.

- Produces water directly from the air.
- It should be easy to design and handle.
- Low maintenance.
- Easy to carry out.

It should be free from hazardous

2. SYSTEM MODEL

Working

This project is designed on the basis of refrigeration principle, which states that is a process in which work is done to move heat from one location to another. The work of heat transport is traditionally driven by mechanical work, but can also be driven by heat, magnetism, electricity, laser, or other means.

Fig. 1 Photograph with Model

All the circuit are designed, and then connections are made as per the diagram as shown below, by using the copper tube of diameter 5 mm and capillary tube of diameter 0.5 mm to the necessary connections. Afterwards creating the vacuum in the component by using vacuum creator. Then refrigerant gas is filled to compressor by using nozzle. Then made supply electric power into the system. The compressor will compress the refrigerant which is filled in system and in converts low pressure vapor into high pressure vapor. Then it moves from the compressor to condenser to condense the gas stream and made it to high pressure liquid then passes to expansion valve i.e. capillary tube. Then the expansion valve will control the flow of air stream which is in the form of high pressure liquid to the evaporator cabin, in the form of low pressure liquid. Therefore due to temperature difference between refrigerant and atmospheric moisture the ice is formed on the surface of evaporator. The heating coil is fixed to this cabin. Then evaporated refrigerant in the form of vapor with low pressure is again circulated to the compressor through copper tube. This process is continued for 1.5 hrs. Then formed ice on the evaporator is defrost to water by using heating coil. Then it is collected by water collector.

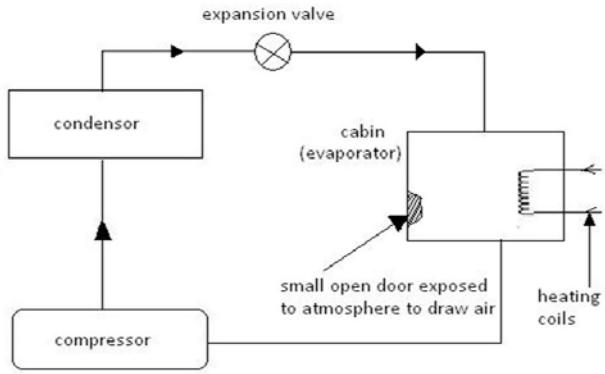

Fig. 2 Circuit Diagram of the Model

Fig. 3 Actual Picture

5. SIMULATION/EXPERIMENTAL RESULTS

After running the system, the ice is formed on the surface of the evaporator as shown in fig.4 above. Then it is heated by heating coil attached to this cabin. So water is formed by the ice is collected by collector and tested for its use. It is fresh water. This water can be drink easily. This experiment is carried out for 2 to 3 refrigerants namely R134a, R290, HC-R290. This system is gives good economy results for HC-R290. Therefore HC-R290 is the best refrigerant to perform this operation. We have collected 250 ml of water for 1.5 hr. The water produced is of cold water. When the system is started the process is running smoothly and no hazardous to the environment. The temperature of the evaporator is decreasing as the ice formation on its surface around 0^{o} C till it will be full covered by the ice.

7. FUTURE SCOPE

This system can be used as dehumidifier also. This can be

moderate to high capacity and more water produced by using higher capacity compressor, condenser, and evaporator. Dehumidifiers are small appliances that remove water vapour from the air. They reduce humidity levels in climates where high humidity levels create uncomfortable conditions in homes or buildings.

This water extractor purifies water for drinking. These units produce distilled water that is perfectly safe to drink. The water generation units use electricity and filters to produce safe drinking water in locations where clean drinking water is in demand. Water generated by dehumidifiers is not safe for drinking unless it is distilled or boiled for at least five minutes to sterilize it. We can also use the solar energy supply for running purpose and can also save the electrical energy. It can be adopted in home also. Extracting water in the home can not only save energy, it can prolong the life of the object that is covered or soaked with water. The machine was rigorously tested and evaluated based on its water production capacity and electrical Usage.

REFERENCES

[1] Naomi J. Blackburn and greg M. Peters,(2001),Atmospheric water generation– an environmentally friendly alternative to bottled water, School of Civil and Environmental Engineering, UNSW Sydney NSW 2052.

[2] David Eriksson and Reza Hashemi,(2008), Evaluation of suitable methods for water generation ,Master of Science Thesis MMK 2008: 43 MCE 160.

[3] J. K. Dabas and A. K. Dodeja, October(2011), Performance characteristics of vapour compression refrigeration cycle under real static conditions, International Journal of Advancements in Technology www.ijict.org, Vol . 2 No. 4.

AUTHOR'S PROFILE

Giriraj Kishore Singh is pursuing his Bachelor of Engineering degree in Mechanical engineering from Oriental College of Technology, Bhopal and course will be completed in June 2017.

Gulshan Singh is pursuing his Bachelor of Engineering degree in Mechanical engineering from Oriental College of Technology, Bhopal and course will be completed in June 2017.

Gautam Ranjan is pursuing his Bachelor of Engineering degree in Mechanical engineering from Oriental College of Technology, Bhopal and course will be completed in June 2017.

A. H. Khan has received his Bachelor of Engineering degree in Mechanical Engineering SATI Vidisha, Bhopal in the year 1996 and He has also received his Master of Engineering degree in Product Design & Engineering from BU Bhopal, At present he is Posted as a Head of Department in Mechanical Engineering Department of Oriental College of Technology Bhopal.

Ashish Chaturvedi has received his Bachelor of Engineering degree in Mechanical Engineering from TIT Engineering College, Bhopal in the year 2011 and He has also received his Master of Engineering degree in Heat power and thermal Engineering from LNCT Engineering College Bhopal, At present he is Posted as a asst Prof. in Mechanical Engineering Department of Oriental college of technology bhopal.

Saumitra Sharma has received his Bachelor of Engineering degree in Mechanical Engineering LNCT, Bhopal in the year 2012 and He has also received his Master of Engineering degree in CAD CAM CIM Engineering from DAVV Indore, At present he is Posted as a Asst. Prof. Mechanical Engineering Department of Oriental College of Technology Bhopal.