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# An Efficiency Study On Water Extraction From Air Using Thermophoresis Method

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**Abstract** : Only three-dimensional of the world's water is H<sub>2</sub>O, and common fraction of that's tucked away in frozen glaciers or otherwise out of stock for our use. As a result, some 1.1 billion individuals worldwide lack access to water, and a complete of two.7 billion realize water scarce for a minimum of one month of the year. An AWG extracts water from air. Water vapour within the air are often extracted by condensation - cooling the air below its saturation point, exposing the air to desiccants. At the same time applying thermophoresis method where the system is cooled to its max and surrounding atmospheric air is forcefully heated such that during there contact water droplets formation is increased and efficiency is increased which would be inversely proportional to the time taken. Even if applying cascade system of refrigeration, the efficiency of water generation from humid air is increased.

## 1. INTRODUCTION

This paper is taken into account as a concept to scale back the water scarcity in several regions. Over 1.2 billion individuals lack access to scrub potable. The speed at that water may be created depends on ratio and close air temperature and size of the mechanical device. Region water generators become simpler as ratio and air temperature increase. The cost-effectiveness of Associate in Nursing AWG depends on the capability of the machine, native wetness and temperature conditions and also the value to power the unit. AWG is Associate in Nursing already existing device. The water extraction capability differs in keeping with the models. By applying thermophoresis technique wherever it had been found that the water extraction from air at its traditional weather temperature with constant wetness is accrued n times (n depends on condenser temperature, evaporator temperature and alternative weather factors) of water extraction from air by forcefully increasing traditional temperature of weather air temperature. The efficiency of water extraction from air is completed by thermophoresis take a look at and condensation method. The efficiency study is completed by testing at completely different temperature and scrutiny them. The test has been done using both thermophoresis method and non thermophoresis method and the graphs are compared. Using thermophoresis method of heat exchange- the hot air pass is more, the temperature inside is less, the water droplets are more so the rate of water production is more. The weight is less compared to old setup. Energy consumption is less and the cost is also low.



## 2. ARCHITECTURE

The design consists of a condenser, compressor, cooling and evaporating coils, filters, storage tank and outlet. In a cooling condensation sort atmospheric water generator, a mechanical device circulates refrigerant through a condenser and so an evaporator coil that cools the air close it. This lowers the air temperature to its temperature, causing water to condense. A controlled-speed fan pushes filtered air over the coil. The ensuing water is then passed into a holding tank with purification and filtration system to assist keep the water pure and cut back the chance expose by viruses and bacteria which can be collected from the close air on the evaporator coil by the compression water. The rate at that water will be made depends on ratio and close air temperature and size of the mechanical device.

Atmospheric water generators become more practical as ratio and air temperature increases. This means they're comparatively inefficient once placed within cool offices. The cost-effectiveness of an AWG depends on the capability of the machine, native wetness and temperature conditions and therefore the price to power the unit.

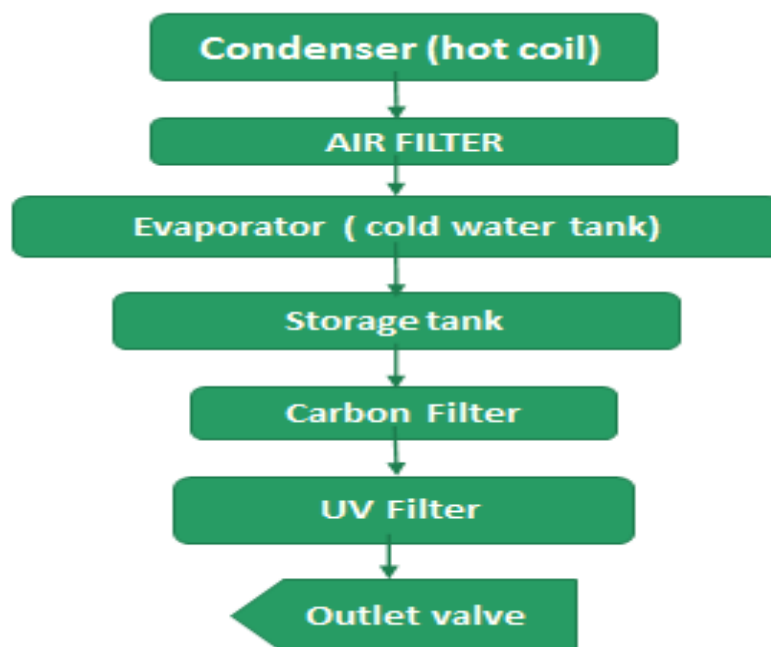


Fig 1. Block Diagram for Aqua Boy

### CONDENSER

A condenser is a device to condense a substance from its air form to a liquid form by allowing it to cool. In thus doing, the heat is given up by the substance and transferred to the encompassing atmosphere. Condensers will be created per various styles, and are available in several sizes starting from rather tiny (hand-held) to terribly massive (industrial-scale units utilized in plant processes). For example, a icebox uses a condenser to induce eliminate heat extracted from the inside of the unit to the skin air. Condensers ar utilized in air conditioners, industrial chemical

processes like distillation, steam power plants and alternative heat-exchange systems. Use of cooling water or close air because the fluid is common in several condensers.

#### EVAPORATOR

An evaporator is a device which is used to turn the liquid form of a chemical substance like water into its gaseous-form/vapor. In this process the liquid is evaporated or vaporized into a gas form.

#### AIR FILTER

A particulate air filter is a device composed of fibrous or porous materials that removes solid particulates like dirt, pollen, mold, and bacterium from the air. Filters containing adsorbent or catalyst like charcoal (carbon) might also take away odors and vaporific pollutants like volatile organic compounds or gas. Air filters are employed in applications where air quality is vital, notably in building ventilation systems and in engines. Some buildings, in addition as craft and different human-made environments (e.g., satellites and area shuttles) use foam, folded paper, or spun covering material filter components. Another technique, air filters use fibers or components with a static charge, which magnetize dirt particles. The air intakes of burning engines and air compressors tend to use either paper, foam, or cotton filters.

#### CARBON FILTER

Carbon filter refers to a way of filtration that uses carbon to separate the impurities of water or air. Carbon filters use a process where the pollutants adhere to the carbon particles as the water or air passes through it. Carbon filters are useful for purifying water and purifying the air of contaminants, but they are also exceptionally useful in removing offending odors from and around indoor gardens.

#### UV FILTER

UV filters are mixtures that block or absorb ultraviolet (UV) light-weight. Two major applications of actinic radiation filters area unit in sunscreens, wherever they shield the skin from sunburn and different injury, and in photography, wherever they scale back the extent of ultraviolet light that strikes the recording medium. When exposed to UV light, these filters can undergo transformations into other chemicals that are less protective and possibly toxic. As a result, there are practical concerns about the choice of chemical to use beyond just which has the desired filtering properties.

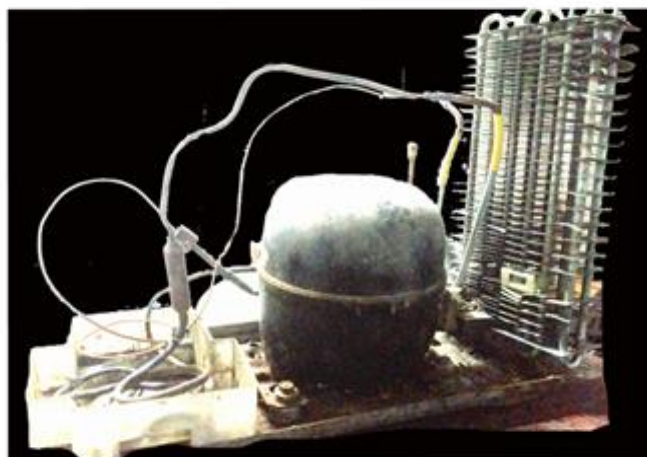


Fig 2. Experimental Setup

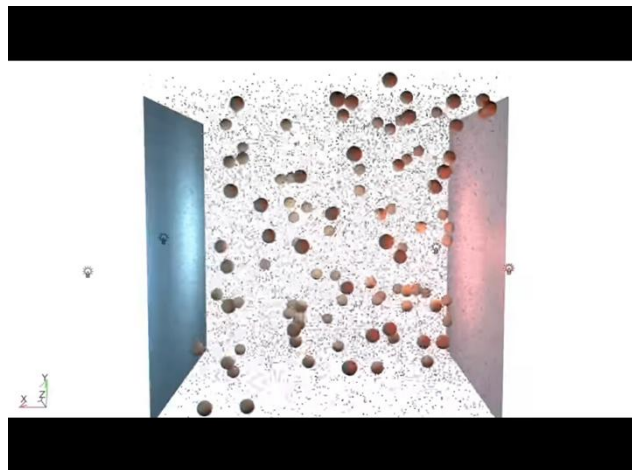


Fig 3. Thermophoresis

## RESULTS AND OBSERVATION

Table 1. PROPERTIES OF R-134a

DENSITY	0.00425 g/cm
BOILING POINT	-14.9°F or -26.1°F
AUTO IGNITION TEMPERATURE	1418°F or 770°F
OZONE DEPLETION LEVEL	0
SOLUBILITY	0.15%

T= Temperature

P= Pressure

h = Enthalpy

s = Entropy

x = Quality( 0 = liquid,1 = vapour)

m = Mass flow rate

m = 3 kg/s

State 2 :

T = 50.9°C

P = 1200kPa

h = 279.3kJ/ kg

s = 0.9301kJ/ kg.K

High Pressure, High Temperature and Superheated Vapour

State 3 :

$T = 46.3^{\circ}\text{C}$

$P = 1200\text{kPa}$

$h = 117.8\text{kJ/kg}$

$s = 0.4245\text{kJ/kg.K}$

High Pressure, Medium Temperature and Saturated Liquid

Non Thermophoresis Test

The day of experiment room temp was noted as 28 degree Celsius with 73% relative humidity. The temperature of the cold body was noted as 11 degree Celsius and was constant during experiment. Under non thermophoresis method when the cold body was substituted in a room with temperature of 28 degree Celsius and 73% humidity and the time taken for water droplet formation for 5 readings.

Table 2. Non Thermophoresis Test

TEMPERATURE	HUMIDITY	TIME TAKEN (min/s)
28°C	73%	1.38
28°C	73%	1.42
28°C	73%	1.35
28°C	73%	1.52
28°C	73%	1.52

Average of 5 readings = 1.438

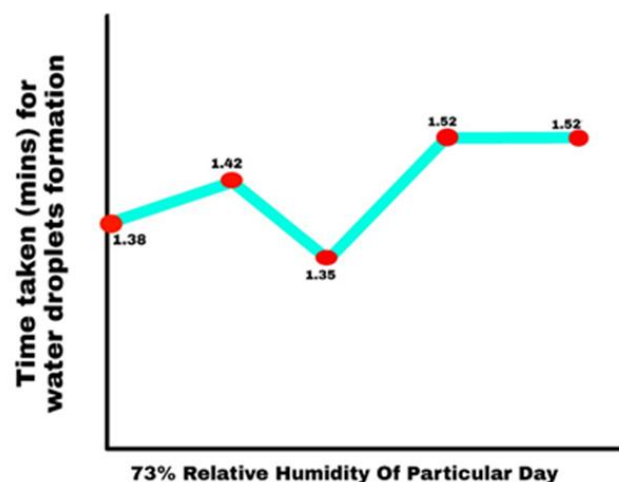


Fig 4. Non Thermophoresis Method  
(experiment done in a room temperature of  $28^{\circ}\text{C}$  and 73% of relative humidity on a cold body with the temperature of  $11^{\circ}\text{C}$ )

## THERMOPHORESIS TEST

Under thermophoresis method the cold body was substituted under the room with temp of 31 deg Celsius (the air inside the room was forcefully passed through the condenser coil to increase its temperature) with relative humidity of 73% and time taken for five readings.

Table 3. Thermophoresis Test

TEMPERATURE	HUMIDITY	TIME TAKEN (min/s)
32 <sup>0</sup> C	73%	1.22
32 <sup>0</sup> C	73%	1.25
32 <sup>0</sup> C	73%	1.31
32 <sup>0</sup> C	73%	1.25
32 <sup>0</sup> C	73%	1.23

Average of 5 readings = 1.252

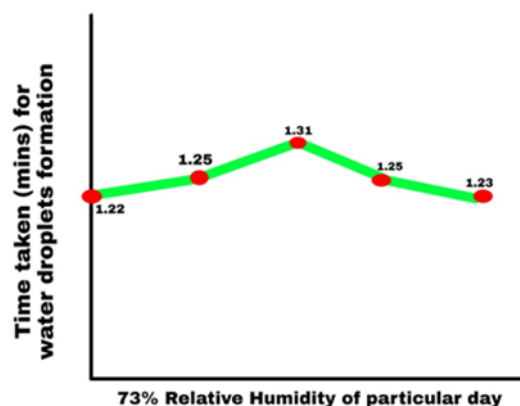


Fig 5. Thermophoresis Method

(experiment done in a room temperature of 31<sup>0</sup>C and 73% of relative humidity on a cold body with the temperature of 11<sup>0</sup>C)

Calculating the change in percentage of time taken for water droplet formation on cold by non thermophoresis method and thermophoresis method.

Avg. non thermophoresis method – Avg. thermophoresis method / avg.time taken \*100

$$1.438-1.252/1.252*100 = 14.85\%$$

## CONCLUSION :

This paper elaborates the design and construction of the atmospheric water generator and the study of its efficiency using thermophoresis method. The readings are taken using thermophoresis method and non thermophoresis and compared at different temperatures. The extraction of water from air is done by thermophoresis test and condensation process.

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