

Extracting Water from Air Using E-Waste of Refrigerator in Combination with Thermo Electric Material

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Abstract. Water is the pulse of any human society. Without clean water human society cannot survive in this world. To fetch one bucket of water people walk many kilometres in Africa. But the available water is contaminated causing diseases and death in children. India generates large amount of e waste including refrigerator. In this paper an attempt was made to extract water from air by using e waste. the air is first filtered and passed in to the compressor. The compressor compresses the air and passes in to the condenser where the temperature of air decreased suddenly. This action results in the formation of ice in the system. The ice melts and gets converted in to water. To increase the conversion ratio peltier effect is incorporated. The water that is extracted is purified by UV rays and tested for drinking purpose. The results prove that the water can be used for utilized for drinking. The system was designed in such, that 10 litres of water can be extracted in 24 hours at a room temperature of 30 degree Celsius with cost of production at 0.15USD.

1. Introduction

Water is essential for every living creatures. Without water living creatures that have breath are prone to death. The holy book of Christians the bible tells that in the beginning world was filled with water and the spirit of god was hovering on the surface of water and god created the land area from the waters proving that every living creature in the land cannot continue their surveillance without water on the surface of the earth. Today the world has 70 percent water and 30 percent land. But the precious lifesaving pure water is perishing or getting contaminated. The world vision points out that 844 million people lack clean water. The result is 800 children under age 5 die due to diarrhea according to the UN water report 2019. The pure natural water is available by rivers and well waters. Where ever the resources for natural pure water is not available science has to extend its helping hands to discover water from available natural resources. The two helping hands of science in generating pure water are desalination technique and extracting water from humidity of air. Desalination techniques[1-3] can be implemented in sea shore cities while the later can be implemented in the interior parts of the country like hilly regions ,rocky areas ,deserts etc. the desalination plant is costly requiring huge investment while the air humidity technique is promising to cheapest compared to desalination plant. In the air humidity method the temperature of the air brought down and by condensation method the water is extracted from it. Klemon [4] reviewed various method to extract water from fog at various location of the world, which uses mesh system setup. The mesh is kept in open atmosphere to have contact with air. When the air hits the mesh, fog droplets are deposited in the mesh. Then droplets are collected in a storage tank. This method was executed in North America, South America, Africa and some Arab countries. The study concludes that method is feasible in all geographical places for collecting water for afforestation and for drinking purpose. But the system

requires large amount of area and cost in erecting large mesh for improving water collection. B Khalel [5] proposed a method of collecting water by using radiative passive collectors which does not require any input energy. Normally radiative active collectors require energy for its operation. Therefore the radiative passive collectors do not give large quantity of water. Mithurun rajaram[6] proposed water extraction from dew by using rashel type meshes which is widely used historically in Chile. In this method the meshes were made up of nano coated materials to exhibit super hydrophobic effect. The super hydro phobic effect will retain the water beads on the outside of the work. Further the pore size were reduced in the meshes which resulted in doubling the quantity of water than normal methods.

Also, an attempt was made to remove water from worn-out parts of refrigeration. The reason is India generates 3 million tons of E-waste annually. E waste includes waste from computer, printers, TV, mobiles, Refrigerator etc. the refrigerator bureau statistics tells that India annually sells 5 million refrigerator. If the life time of refrigerator is 10 years then one can predict annually India would generate 2.5 tons of refrigerator as E waste. The e waste of refrigerator consists of compressor, condenser, dryer etc. Some of the E waste can be reused or recycled and prevent environmental damage to the society. In this paper an attempt was made to get generate water from e waste of refrigerator.

2. Methodology Adopted

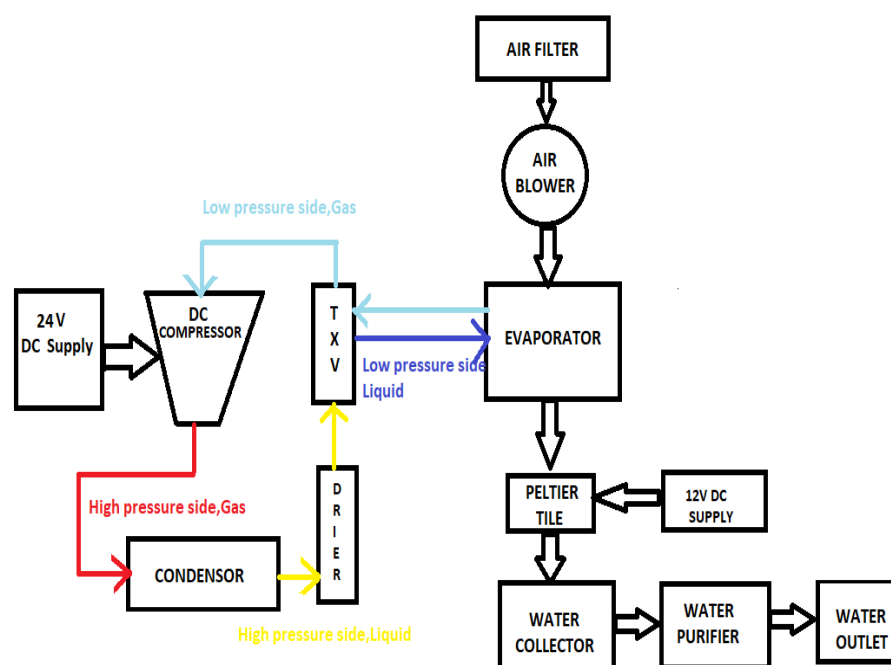


Figure 1.Representation of adopted work

In this proposed system Humid Air is filtered by Air filter and pure air passes over the air blower (brushless DC fan) it collect the air and it is condensed in the evaporator coil and peltier tiles. Humid air is condensed and the water droplets is collected in the water collector. From water collector water is filtered using charcoal filter and UV Ray and water is purified. Working of cooling system is the Dc compressor is driven by dc source of 24v and the compressor compress the gas with 16 bar pressure and with temperature of 85 degree Celsius. Now the compressed gas is moved into the condenser coil the Freon gas (R-134a) due to the surrounding temperature. The temperature of Freon gas is reduced to 45 degree Celsius and pressure remains the same. From the condenser gas phase of the Freon is changed into

liquid phase. Now liquid gas is moved into drier so that the gas from the condenser is totally removed and the liquid moves to the TXV (thermal expansion valve). From TXV the pressure is reduced to 3 bar and its temperature is reduced to 0 degree Celsius. So the cool liquid of Freon is moved to the evaporator coil and it cools the surface around the evaporator. And once the cooling of the evaporator occurs the liquid phase of the Freon is changed into gas phase and the cycle continues and it attain the dew point in the surroundings of the evaporator and it condense the humid air present in the atmosphere and water is extracted from the proposed system.

There are a few focal points to this methodology. To start with, it is established on many years of specialized work and advancement. Besides, it is an extremely immediate methodology and moderately easy to assess given psychometric hypothesis and the inert warmth of buildup. An essential drawback to this methodology is the size of the warmth move expected to produce a noteworthy amount of water. For all intents and purposes all business climatic water generators use this way to deal with cooling framework.

2.1 Vapour Compression Method

Fume pressure refrigeration is the most generally utilized technique for cooling in this day and age. Basically the framework has four segments: a blower, a condenser, a warm alve and an expansion evaporators. Coursing refrigerant enters the blower as 21saturated fume and is compacted. This outcomes in high weight which thusly is answerable for higher temperature. The packed fume at that point comes out as superheated fume and accomplishes a temperature and weight at which buildup can occur with the assistance of cooling water or cooling air.

A fan flows the warm air in the encased space over the curls conveying the cool refrigerant fluid and fume blend. That warm air dissipates the fluid piece of the chilly refrigerant and simultaneously, the circling air is cooled and accordingly it brings down the temperature of the encased space to the temperature to be accomplished. The coursing refrigerant ingests and expels heat from the evaporator which is then dismissed in the condenser and moved by the water or air utilized in the condenser. For the consummation of the refrigeration cycle, the refrigerant fume coming out of the evaporator which is again an immersed fume is returned once more into the blower.

The fume pressure cycle comprises of a refrigerant that goes through a progression of changes in a shut consistent cycle. It comprises principally of four stages Refrigerant gas at low weight enters the blower and leaves it pressurized. All the while, the gas temperature additionally increments and it makes it simpler to process the warmth move because of occur in the following stage. The high temperature, high weight gas at that point enters the warmth trading (condenser) loops and discharges the warmth to the environmental factors. In this progression, the refrigerant gas turns into a sub-cooled high weight fluid. The high weight fluid at that point goes through the extension valve that in a split second decreases the weight and temperature of the refrigerant. The chilly fluid refrigerant experiences the evaporator, engrossing warmth vitality from the environmental factors. The warmth engrossing prompts a vanishing of the refrigerant fluid into low weight gas. The low weight gas at that point streams back to the blower and the cycle proceeds if there should arise an occurrence of cooling framework, the warmth consumed by the refrigerant in the evaporator step cools the curls and, along these lines, the water fume noticeable all around being disregarded them gathers on the virus loop surfaces. This water is then gathered and sifted to produce unadulterated, drinking water.

2.2 Filtration Unit

The water got from the gadget after buildup isn't fit for drinking. It contains a ton of germs and hurtful microscopic organisms which may cause illnesses. Additionally it contains suspended particles which should be sifted through. Charcoal separating is a strategy for sifting that utilizes a bed of enacted charcoal to evacuate contaminants and polluting influences, utilizing concoction adsorption. Every molecule/granule of carbon gives an enormous surface region/pore structure, permitting contaminants the most extreme conceivable presentation to the dynamic locales inside the channel media.

Enacted charcoal works by means of a procedure called adsorption, whereby toxin atoms in the liquid to be dealt with are caught inside the pore structure of the charcoal substrate. Charcoal sifting is regularly utilized for water cleansing, air separating and modern gas handling, for instance the expulsion of hydrogen sulfide from biogas. It is likewise utilized in various different applications, including respirator covers, the refinement of sugarcane and in the recuperation of valuable metals, particularly gold.

This can be accomplished by first passing the consolidated water through enacted charcoal channel. At that point it is exposed to UV light in order to slaughter the hurtful microorganisms.

The advantages of the proposed system given below,

- Highly portable Machine
- It is easy to Maintain
- It is Convenient, Dependable, and safe.
- It is applicable in all climatic condition.
- Water is clean, pure and Non Toxic
- UV Ray treatment ultimately eliminates hazards caused by viruses, bacteria etc.
- It can produce 10 liters of water per day.

3. INDIVIDUAL COMPONENTS DESCRIPTION

3.1 Compressor

A Reciprocating compressor is used in the machine to operate the cooling system. It consists of inlet (suction line), outlet (Discharge line) with input supply of 160/250 Volts and 1.2 amps.

3.2 Condenser

It is used to consolidate a substance from its vaporous to its fluid state, by cooling it. In this manner, the inactive swarmth is sour rendered by the substance and moved to the general condition.

3.3 Evaporator

The evaporator works something contrary to the condenser, here refrigerant fluid is changed over to gas, retaining heat from the air in the compartment. At the point when the fluid refrigerant reaches the evaporator its weight has been diminished, scattering its warmth substance and making it a lot cooler than the fan air streaming around it encompassing.

3.4 Peltier

A 30x30 mm thermoelectric cooler (TEC-12704) has been used in your project. This device is otherwise named as peltier plate. These coolers make a temperature differential on each side. One side gets hot and the opposite side gets cool.

3.5 UV Ray

Bright water filtration is the best technique for sterilizing microorganisms from the water. Bright (UV) beams enter destructive pathogens in your home's water and decimate ailment causing microorganisms by assaulting their hereditary center (DNA). This is very proficient in wiping out their capacity to replicate. Purifying your water with Ultraviolet light is exceptionably straightforward, successful and ecologically protected. UV frameworks pulverize 99.99% of destructive microorganisms without including synthetic compounds or changing your water's taste or scent.



Figure 2.Snap shot of UV water purifier

Step By Step Procedure to Make Working Model

- The compressor and evaporator is fixed permanently by welding process and done perfectly
- The condenser has been added to complete the refrigeration cycle
- The Freon gas (R-134a) has been filled completely and dew point has been reached. And the freezing stage has been reached.
- The working model has designed and finished its outer cover with Aluminium sheet
- The working model has been modified with water collector, water filter, UV Ray has been placed in order to produce purified atmospheric water.
- In this stage we have added peltier in the working model. We finalized our prototype model with complete hardware.

4. RESULTS AND PERFORMANCE ANALYSIS

After testing the prototype for one hour, condensation was formed in the evaporating coil is shown in figure 3 as finalized working model.



Figure 3.Working Model of Proposed work

5. PH analysis of atmospheric water

The generated atmospheric water is tested in the PH analysis in our chemistry lab. The test results are given in table 1. The snapshot of PH test value given in figure

Table.1 PH analysis

S. No.	Parameter	range
1	Source	Atmospheric water
2	Appearance	Clear
3	Color	Colorless
4	Odor	Agreeable
5	PH value	8.41



Figure 4.PH test value for Atmospheric water

4.2 Total Hardness Test for Atmospheric Water

In this test analysis total hardness of water is calculated by titration method and the result proves that given sample turns wine red to steel blue color as a indicator. This result is shown in figure 5.



(a) Titration -1

(b) Titration- 2

Figure 5.Hardness test for Atmospheric water a & b

The total hardness of water is calculated as 117.8ppm. The test result proves that the atmospheric water is best suited for drinking. The table 2 indicates the standard specification of drinking water. The table 3 indicates the test result of atmospheric water. The test results are taken from private laboratory Chennai, India. The test values of atmospheric water in table 3 are well matched with the standard specification of the drinking water. The test result proves that the atmospheric water is best suited for drinking.

Table 2 Indian Standard Specification for Drinking Water

S.No.	Parameters	Limit	Remark
1	Colour	5	May be extended up to 50
2	Ph	6.5 To 8.5	May be relaxed upto 9.2 in absence
3	Turbidity	10	May be relaxed up to 25 in absence of alternate
4	Calcium	75	May be extended upto 200
5	Magnesium	30	May be extended upto 100
6	Total Alkalinity	200	May be extended upto 500
7	Chloride	250	May be extended up to 1000
8	Sulphate	150	May be extended up to 400
9	Total Dissolved Solids	100	May be extended to 500
10	Total Hardness	300	may be extended up to 600

Table 3 Test result for Atmospheric water

S. No	Parameters	Method	Unit	Limit	Remark
1	Colour	IS 3025 (part4)-1983 (R.2006)	HU	2	May be extended up to 50
2	Ph	IS 3025 (part11)-1983 (R.2006)	-	6.7	May be relaxed upto 9.2 in absence
3	Turbidity	IS 3025 (part10)-1983 (R.2006)	NTU	5	May be relaxed up to 25 in absence of alternate
4	Calcium	IS 3025 (part40)-1983 (R.2006)	mg/l	11	May be extended upto 200
5	Magnesium	IS 3025 (part46)-1983 (R.2006)	mg/l	3	May be extended upto 100
6	Total Alkalinity	IS 3025 (part23)-1983 (R.2006)	mg/l	47	May be extended upto 500
7	Chloride	IS 3025 (part32)-1983 (R.2006)	mg/l	22	May be extended up to 1000
8	Sulphate	IS 3025 (part24)-1983 (R.2006)	mg/l	4.8	May be extended up to 400
9	Total Dissolved Solids	IS 3025 (part16)-1983 (R.2006)	mg/l	92	May be extended to 500
10	Total Hardness	IS 3025 (part21)-1983 (R.2006)	mg/l	41	may be extended up to 600

6. CONCLUSION

Water is an essential in all living creature life but there is a scarcity for drinking water because of land pollution, water pollution air pollution etc. In order to make water available for drinking purpose various technology are available. In this project we have proposed a method to convert the atmospheric air in to water .Water produced by this method was tested for various parameter such as PH, Turbidity, Total Alkalinity of calcium carbonate, Total Dissolved Solids, Total Hardness of calcium carbonate and Mineral test such as Calcium, Magnesium, Chloride and Sulphate. The Results Obtained are within the ISO specified limits, therefore water can be used for Drinking. The prototype Model consumes 1 unit of energy in 24 hours and generated water upto 10 liters per day. In order to increase the water quantity we need to increase the speed of the fan to blow the air throughout the coil and to increase the capacity of the compressor to mingle the Freon gas throughout the structure.

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