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Design and Fabrication of Solar Powered Water Dispenser

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Abstract

In water dispensers available in today's market have a compressor for cooling water and heating element to heat the water along with a lot of other secondary devices. Use of these hefty devices make this water dispenser heavy, bulky and consumes more power. Its compressor releases cfc which are very handy in ozone layer depletion. Our aim is to eliminate these limitations from the conventional water dispenser. We will create a potential difference using solar isolation to achieve the temperature difference.

Keywords: Peltier Effect Thermocouple, Refrigeration, Solar Powered Water Dispenser

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1. Introduction

In the water dispensers available in today's market have a compressor for cooling of water and a heating element to heat the water along with a lot of other secondary devices. Conventional refrigeration is the process of removing heat from an enclosed space, or from a substance, and rejecting it elsewhere for the primary purpose of lowering the temperature of the enclosed space or substance and then maintaining that lower temperature. Cooling is the natural or artificial process by which heat is dissipated. Cold is the absence of heat, hence in order to decrease temperature, one removes heat, rather than adding satisfy the Second Law of Thermodynamics, some form of work must be performed. This work is traditionally done mechanically but can also be done by other means..

Innovation in the field of Refrigeration lies in the fact that what we are doing to reduce or eliminate the excretion of CFCs used in coils and compressors. Efforts are being made to develop an electric field refrigeration unit (as electricity is more convenient) and in the future, we can envision a flat-panel refrigerator with no coils and compressors, but solid polymer with appropriate heat exchangers. Researchers are working with ferroelectric polymers that exhibit temperature changes at room temperature under an electrical field. These polar polymers include poly (vinylidene fluoride-trifluorethylene) and poly (vinylidene fluoride-trifluoroethylene)-chlorofluoroethylene.

Water dispenser is a kind of Peltier works on the Seebeck Effect also known Device/Thermoelectric Device available in the market which as Thermoelectric Effect. Tiisthermoelmecatdrie coeffftewcot states that if a temperature difference is n created across a suitable arrangement dissimilar semiconductors (p-type & n then the free electrons available in n-type -ytype) connected side by side on a common platform semiconductor and free holes available in p-type semiconductor will diffuse from hot side towards the Cold side. This diffusion of charge carriers from hot side to cold side create a voltage difference due to which an electricity flow ets established. The arrangement we are talking about is very small in size and thus creates a very tiny amount of electricity but if we arrange a large number of such arrangements between two plates one of which is colder comparatively than the other plate which is hotter. In this case all those small modules will combine to generate a considerable amount of electricity. Any such arrangement with a large number of modules connected together is called Peltier Device. 5.1 Thermoelectric Cooling In theory if a device creates a potential difference when both sides of the device is It means it should create a subjected to different temperature then it should work vice-versa. We connect the pelt device to a battery temperature difference across its both panels when s. Now we can use this property and its internal construction supports this theory in all aspect of the device to cool Water below its normal temperature or heat it up above its normal temperature.

2. Design and Methodology

With the peltier effect thermocouple causes a temperature difference between the junctions of the different materials Phenomenon that is potential difference applied across a in the thermocouple. Since the hot junction can be placed outside of an insulated area, and the cold junction can be placed inside the region, the Peltier effect can be used to cool this reverse Seebeck effect or Peltier effect. region (or an object).

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According to the requirement our main aim is to cool water using this previous chapter is Prepared according to the calculation done. For calculation theory and A highly updated design which is explained in formulae from different branches like thermodynamics, heat and mass transfer, fluid mechanics is applied. Methods from electronic circuit theory are also applied. This mixed use of theory make this project more of mechatronics field. Different parts used in the solar panel water dispenser are explained below

2.1 Peltier Cooler Module

The heat-sink side of the TEC gets very hot, so it is necessary to have a fan and/or some sort of radiator to dissipate this heat. Otherwise, the entire TEC would begin to heat up, and pieces would fuse together. Normal Peltier elements are roughly a few centimeters thick and a few millimeters or centimeters on a side. To obtain greater cooling abilities, the individual elements are connected in stacks, or they can be connected in some combination of series and parallel electrical connections. According to our requirement four modules are used to cool the water tank of size 500 rnl. All four peltier modules are contact with the heating arranged in such a way that all are connected in parallel on four side of the water tank Cli is in contact with the wall of cooling tank whereas .long surface of peltier, heating side is in tank. Heating is done by the exhaust air from fan which is at high temperature from normal.

2.2 Water Tank

There are total of three tank used in the solar power water dispenser. These are cooling water tank, heating water tank and reservoir tank. Material used in making these tanks is aluminum because aluminium is best available conductor of heat in market. And at the same time it's easily moldable and light. Capacity of cooling water tank and heating water tank is 500m1 both and the reservoir tank has capacity of lilt altogether as it have to compensate water requirement of both heating water tank and cooling water tank. By working model point of view reservoir tank is placed at some height above the other two tank develop head so that water flow between these tank under pressure.

2.3 Solar Panel

Main aim of this project is to provide clean fuel energy that is why solar energy is used by attaching a solar panel which will convert solar energy into clean electric energy. We are using a detachable solar panel which is used to charge the battery. Solar panel as per the calculation and in project point of view is taken of smaller dimension in comparison to which Can be used in real application. In the model presented, dimension of solar panel required ts 5sqleet. As per the experimental result a pair solar panel will take around 4 hours to charge the battery which is of 12 volt, 7.2 Ah. ery is connected to solar panel to charge the battery so we are using rechargeable In this nese batteries could be charged within 4 hours. Since batteries supply Direct

2.4 Transformer

As battery articled works on 1 volt 7.2 Ah, it is required to decrease the n current intensity. For which a step down transformer is used *step do ii transformer is a connection to decrease th between battery and i ar er device. We e using step down transformer because it is required the amount pelt of mains supply as sunlight current. As we also provided the method of charging battery by t is not available in evening required which therefore stepping down of current is is further fulfilled by transformer.

2.5 Rectifier

As the current supply from battery to transformer is still A.0 which is not our requirement because peltier cooling effect on different side of surface is only achieved when D.0 is supplied. For this requirement an A.0 to Derter between transformer and pettier cooler modules .0 conv i.e. rectifier is attached.

2.6 Base Material

This whole setup requires a base which mentioned elements of solar power water dispenser condition of electric shock and provided with components are firmly fixed by using a glue solution is used to hold the assembly of above . Material chose is wood as to prevent any better earthing. On this base different It

2.7 Dispensing tap

Cooling water tank and heating water tank is provided with dispensing tap through water pipe. Both taps have colour indication on it i.e. blue colour for cool water and red colour for hot water.

3. Specifications

Metal Used: Aluminium

Insulating material: PUF capacity of Peltier Device-60 Watt ,/ &
Peltier Peltiers used- 4 fan's power---1 0 Watts/fan fans Used-.4
Volume of Hot Chamber-340 ml

4. Dimensions of Hot Chamber

Length---6.2 cm Width-----3.6 cm Height-15.3 cm Thickness =2.4 mm

Volume of Cold Chamber= 340 ml

5. Dimensions of Cold Chamber

Length-6.2 cm
Width=3.6 cm
Height=15.3 cm
Thickness=2.4 mm
Time for Cooling-30 minutes
Time for Heating-30 minutes
Degrees cooled=l5°C

6. Power Supply

2 Rechargeable Batteries
Rating: 12 Volt, 7.2 Ah
Solar Panel Capacity=50 Watt Solar Panel Dimension-5 sq.feet

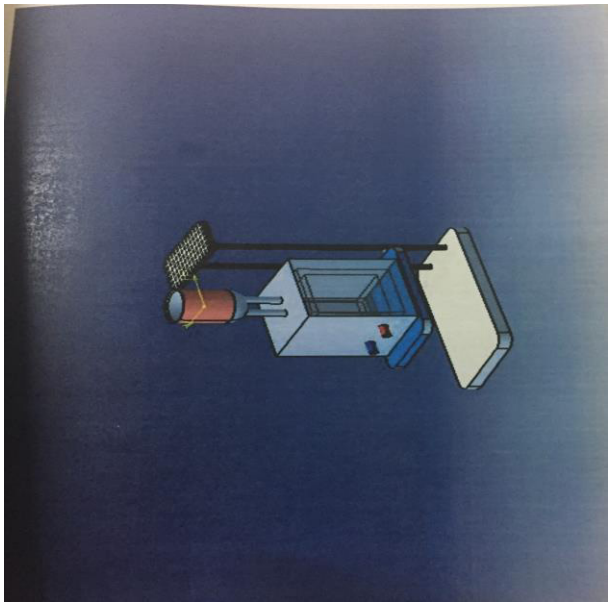


Figure 1. Preliminary Design.

7. Calculations

Time taken by the system to cool the water= 30 minuets= 1800 seconds

Work done on the system= 60×30×60×4J=432000J Entropy generated in the system=m×c×lnTf/Ti+Q/T0 Inideal condition entropy generation is 0

So m×c×lnTf/Ti+Q/T0=0 M×4182×ln293/308+432000+m×4182×15/308=0

the value of m from the above equation We got m=3.412 kg

Since Second law efficiency in most of the cases is found to be 10% of the ideal

So. mass that can be cooled is -1 x 3.412kg = .3412kg. = 341.2 ml

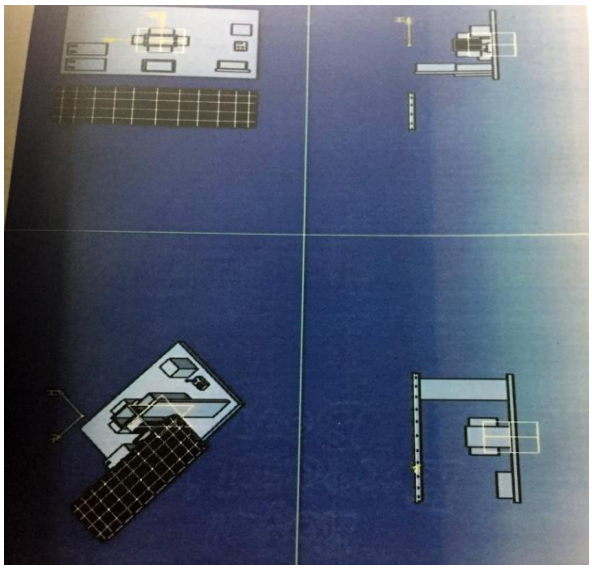


Figure 2. Updated Design Multi View.

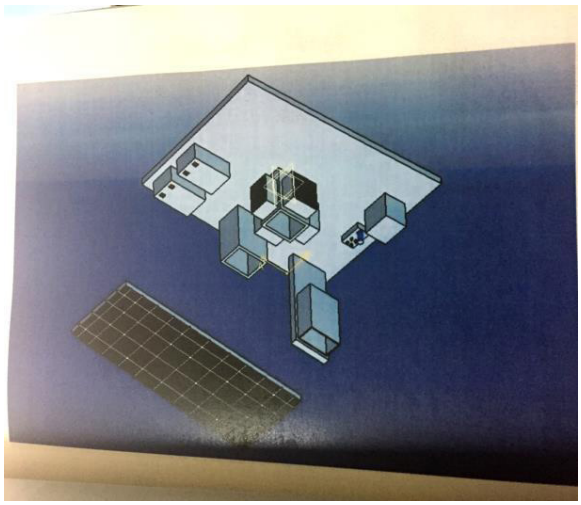


Figure 3. Updated Design- Isometric View.

8. Dimensions of the cooling Chamber

mass of water to be Cooled by the Peltier --- 341.2ml we know 1 m^3 = 1000L

So, Volume of container = 3.412x 10-4 m^3

cross sectional Area of Aluminum Container Available =3.6x6.2 cm^2

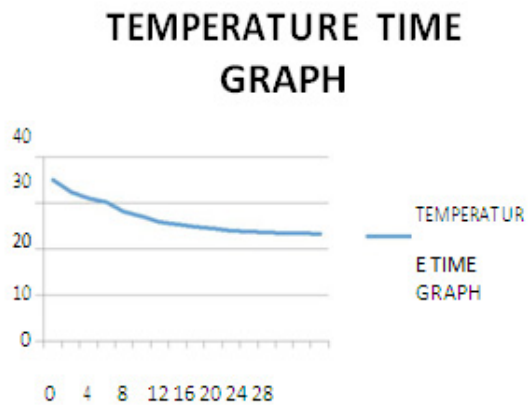
so height of container Height will be 15.28 cm.

9. Capacity of Heating Coil

Dimensions of heating chamber=15.28x3.6x6.2 cm^2 Time taken=1800 sec

Temp difference=150c
Capacity of heating coil= .3412 x 4180 x 15 1800
Time taken for heating the box is 720 sec

10. Results and Discussion



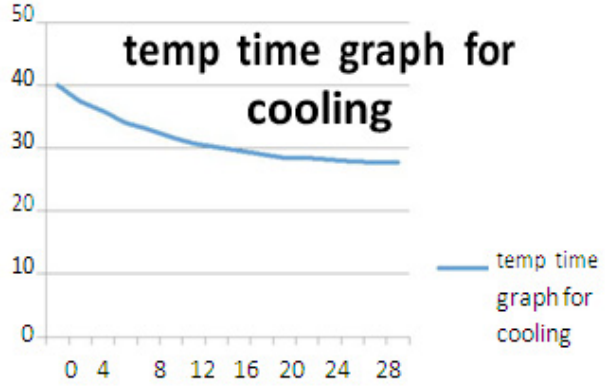
TEMPERATURE-TIME GRAPH FOR COOLING OF 40^{0}C WATER

Time (min)	0	2	4	6	8	10	12	14
Temperatur e(c)	40	37.4	35.9	34	33	31.7	30.7	30.1
	16	18	20	22	24	26	28	30
	29.6	29	28.5	28.4	28.1	27.9	27.8	27.7

With the peltier effect thermocouple causes a temperature difference between the junctions of the different materials .Due to this Phenomenon the potential difference applied across a in the thermocouple and a potential difference exist using solar isolation to achieve the temperature difference.

Expected fall in temperature= 150c Actual fall in temperature= 120c

Actual time taken for cooling upto this temperature is 30 minutes



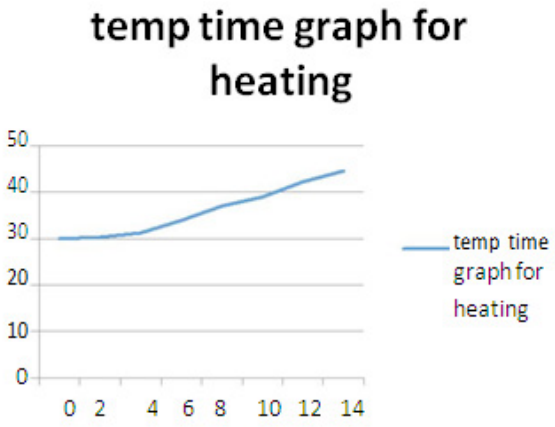
TEMPERATURE-TIME GRAPH FOR COOLING OF 50^{0}C WATER

Time (min)	0	2	4	6	8	10	12	14
Temperature(c)	35	32.3	31.1	30.1	28.1	27	25.8	25.3
	16	18	20	22	24	26	28	30
	24.8	24.4	24	23.7	23.5	23.4	23.4	23.3

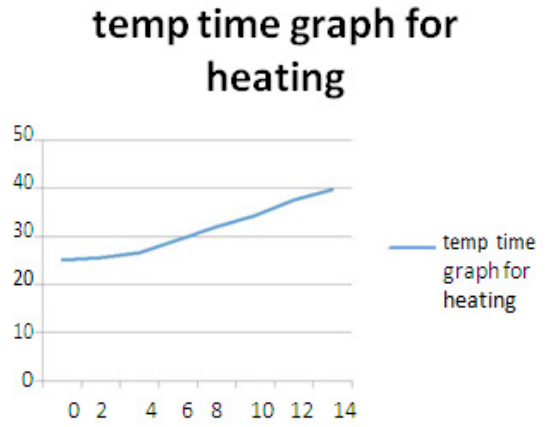
IN HEATING CHAMBER

Expected rise in temperature= 150c
Actual rise in temperature=140c
Expected time taken for heating= 12 min
Actual time for heating= 14 min

Time (min)	0	2	4	6	8	1	12	14
Temperatur e(c)	30	30.4	31.3	34	37	39	42.2	44.4



Time(min)	0	2	4	6
Temperature(c)	25	25.6	26.6	29.2
	8	10	12	14
	32	34.3	37.5	39.7



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Conflict of Interest:

Author of a Paper had no conflict neither financially nor academically.