FABRICATION AND ANALYSIS OF SELF CONDENSATION MACHINE

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Abstract-*Scarcity of water is of much concern and one of the most neglected problems which around 1.2 billion people suffer from it. This research work was undertaken keeping this very fact and its attribute. Moisture content present in air is an overlooked source of water and by scrupulously mulling the potency of this work, the credibility is germane to the practibility of the entire work. The finding is based on the principle of Peltier-effect. Peltier module has been used for the condensation of moisture present in air or more precisely cold side of Peltier module is indispensable element of it. This finding was assimilated with different methods and designs. The upshot of the designs precedented led to conflagration for the pertinent design to be brought into effect and consequently led to improve the efficacy. Thus, the final design was assembled with seven Peltier modules consociated with heat sinks on the hot side. In addition to this, a provision was made for admittance of fresh air and eradicating the hot air after extraction of moisture from air. Thermal grease was interfaced between hot-side and heat sink to mitigate the air void that had been done to augment the rate of heat-transfer. On the other hand, a comparison was made by operating the Peltier module in open alongside the final design. After analyzing the designs, it was concluded that while using the Peltier module for the said purpose prime focus should be given on eradication of hot air from the chamber or whatsoever design is given to the machine. Moreover, the fact that when there is greater difference between dry-bulb temperature and wet-bulb temperature relative humidity will be less and vice-versa was re-established.***

1. INTRODUCTION

Water is one of the most essential staples on earth. All living beings be it animals or plants need water. Its use is not only restricted to drinking for survival but can be used for other purposes too. Sources of water are many ranging from surface water to underground water. At this point we would like to emphasize on the fact that water from air is an overlooked source of water. This overlooked source is the essence of our research coalesced with the adoption of Peltier cell. The dogma lies in thermo-electric cooling. Thermo-electric cooling employs the Peltier effect to create heat flux between the junction of two different types of materials.

The Peltier device consists of two sides, heat is transferred from one side of the device to the other which is dependent on the direction of current. When a Dc current is allowed to pass through the Peltier device, one side gets cooler while the other gets hotter. Heat sink is attached to the hot side in order to keep it near the ambient temperature while the cool side goes below the ambient temperature. To obtain different electron densities in Peltier device two unique semi-conductors (one n-type and one p-type) are placed thermally in parallel and electrically in series, which are then inter-wined with a thermally conducting plate on each side.

Upon application of voltage to the free terminals of the two semi-conductors there is a flow of DC current across the junction of the semi-conductors causing a temperature difference. The side with cooling plate absorbs and transfers heat to the other side where heat sink is.

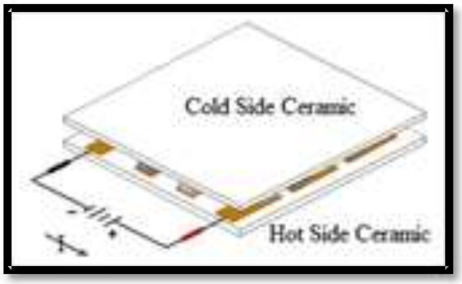


Fig. 1.1 Peltier-Cell

2. METHOD

The prime concern for the research undertaken was to maintain and increase the efficiency of the Peltier-cell which implied a need of design and its improvisation.

Design 1- Conceptualization of design initiated with the use of a single Peltier-cell was of a water bottle. The hot side was annexed with a heat-sink of rating 12V DC and 0.17A. By scrupulously adopting this method, we inferred that the condensation rate was very slow and modicum droplets of water was witnessed.

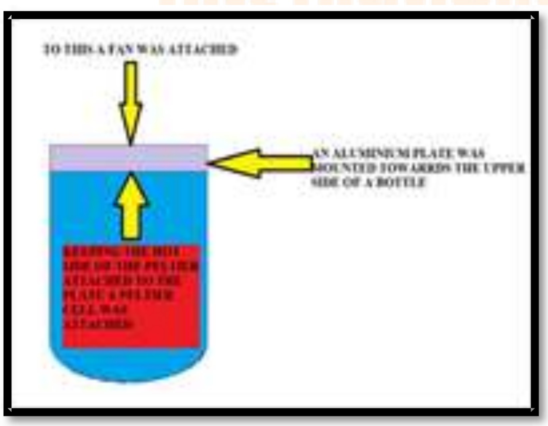


Fig 2.1 Design 1

Design 2- When the number of Peltier-cells was inflated to twenty in order to achieve desired output which incorporated with the change of heat-sink. This change of heat-sink was adopted in order to enhance the rate of heat-transfer. In this design radiator of vintage car was employed as a heat-sink. Additionally, thermal paste was used as an interface between heat-sink and radiator to mitigate air-voids.

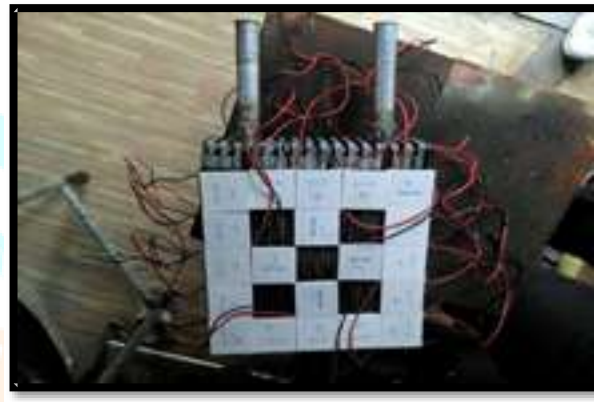


Fig. 2.2 Design 2

Design 3- In this design aluminium fins was employed as a heat-sink together with a fan with 5000 RPM. This analysis was done in order to understand the variation of condensation rate with respect to the rpm of the fan.

Fig. 2.3 Design 3

Design 4 –The upshot of the designs precedented led to conflagration for the pertinent design to be brought in effect and consequently to improve the efficacy. An erudition for different heat-sinks was an integral part that may lead to distinct attribute. Hence, four different heat-sinks were taken and analyzed having different ampere ratings and fin orientation. Below is the voltage and ampere ratings of the heat-sinks we rationalized:

S.NO	DC VOLTAGE	CURRENT
1	12 V	0.14A
2	12 V	0.27A
3	12 V	0.60A

The fourth heat-sink was cooler master hyper 103.The dimension of the heat-sink was 8.9×10.8×13.8 (cm). The power consumption was 1.8 watts.

Furthermore, analyses were carried in two different conditions. Firstly, Peltier-cell attached with heat sink was kept in open space at ambient conditions.

Secondly, Peltier-cell was in a chamber and in both of them different results were obtained.

Fig. 2.4 Design 4

In addition to it both analyzation was done by operating the Peltier-cells in both the ways simultaneously.

Below are the observations of attributes in both conditions.

3.OBSERVATIONS

AVERAGE OF FIVE DAYS IN MORNING						
	AMBIENT CONDITIONS			INSIDE CHAMBER		
AVERAGES OF EACH DAY	DBT (°C)	WBT (°C)	RH (%)	DBT (°C)	WBT (°C)	RH (%)
DAY 1	30	21.1	49.6	32.3	21.7	40
DAY 2	24	17.1	58	28	18	40.3
DAY 3	25	17.03	53	30.6	17.4	32
DAY 4	26.7	18.2	55.4	30	18.6	47.3
DAY 5	26.3	18.4	51.3	31.3	18.7	34.3
AVERAGE	26.4	18.36	53.46	30.44	18.88	38.78

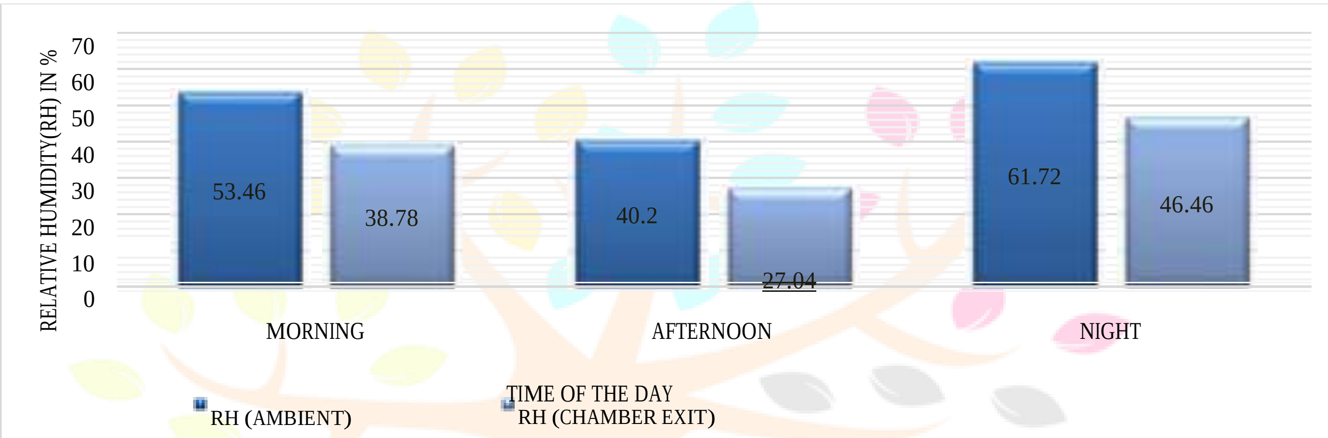
AVERAGE OF FIVE DAYS IN AFTERNOON						
	AMBIENT CONDITIONS			INSIDE CHAMBER		
AVERAGES OF EACH DAY	DBT (°C)	WBT (°C)	RH (%)	DBT (°C)	WBT (°C)	RH (%)
DAY 1	30	21.1	43.6	34.3	24.2	34.6
DAY 2	30.6	19.8	33	35.6	18.5	17.3
DAY 3	31	19.9	43.6	34.6	21.03	29.6
DAY 4	32.7	23.9	38.4	36.7	21.4	21.7
DAY 5	32.7	21.3	42.4	35	22.03	32
AVERAGE	31.4	21.2	10.2	40.2	27.04	13.16

AVERAGE OF FIVE DAYS AT NIGHT						
	AMBIENT CONDITIONS			INSIDE CHAMBER		
AVERAGES OF EACH DAY	DBT (°C)	WBT (°C)	RH (%)	DBT (°C)	WBT (°C)	RH (%)
DAY 1	28.3	21.6	60.6	31.6	21.6	40.3
DAY 2	25	19.9	64.6	27.3	18.8	49.3
DAY 3	27.3	21.9	63	29	20.8	49
DAY 4	27.4	21.5	59	29.4	20.9	46
DAY 5	26.7	20.7	61.4	29	20.9	47.7
AVERAGE	26.94	21.12	61.72	29.26	20.6	46.46

TIME OF THE DAY	DBT (°C)	WBT (°C)	□T	RH (AMBIENT)	RH (CHAMBER EXIT)	□RH
MORNING	26.4	18.36	8.04	53.46	38.78	14.68
AFTERNOON	31.4	21.2	10.2	40.2	27.04	13.16
NIGHT	26.94	21.12	5.8	61.72	46.46	15.26

From the above table which shows the difference between dry-bulb temperature

(DBT) and wet-bulb temperature (WBT) and corresponding difference in relative humidity (RH); it is clearly evident that when difference between DBT and WBT is greater then the RH is lesser and vice-versa.



RH = Relative Humidity

Fig 3.1 Figure showing variation of RH in different times of the day

4.RESULT

After all the analysis done in a chamber, there was no formation of ice, modicum droplets of water were noticed which could be measured even in milliliters.

On the other hand, when the same experiment was carried out in ambient conditions, fairly thick layer of ice was witnessed on the cold side of Peltier cell in all the different phases of a day. As the power supply is turned off after 15 minutes, 5 milliliters of water were collected in the collector. The work was done with seven Peltier cells.

Hence, there is a wide variations in result when Peltier-cell is used in chamber than at ambient conditions.

5. CONCLUSION

From the inspections and analyzation, it has been re-established that when the difference between dry-bulb temperature and wet-bulb temperature is greater then the relative humidity is less and vice- versa.

Moreover, when the Peltier cells are used in ambient condition then the quantity of water droplets is significant in comparison with their attribute in the chamber.

When Peltier-cells were used in chamber it behaves more as de humidifier than water extracting machine.

It may also be noted that if somehow, the design is changed and converted into a bottle shape, it will highly be portable. Moreover, the prime focus must be given for the eradication of hot air.

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