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INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

TITLE: Review paper on Development of Modified Solar Air cooler using peltier

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Abstract

One of the major problem that comes with summer season is rise in the temperature of water for both domestic and commercial building usage. At a persistent high temperature up to 45 degree Celsius people have to face challenging and sometimes unbearable hot water for drinking, bathing, and other general use.

Cooling this water using conventional cyclic refrigeration is usually met with huge energy consumption that leads to upsurge in electricity tariff, and indirect rise in environmental pollution associated with all processes involved.

By solar energy during this period with a cooling technique based on thermoelectric device an effective solution approach is proposed in this study. The proposed method is based on the philosophy of cooling the water .

We are cooling the water in the tank that will then circulate through condenser tubes . This will help in cooling the air which would pass through it. Hence our objective is to get cool air at less time.

Keywords *- Evaporative Cooling, Heat Transfer, Air Cooler.*

I. INTRODUCTION

India is a tropical country in which most of the regions experience very low temperatures during the winter and very high temperatures during the summer seasons. That is, the temperature range between summer and winter seasons is very large. Hence, it is not a very pleasant experience and highly uncomfortable. Though cheaper methods of heating are available during the winterseason, methods of cooling down the hot temperatures during the summer do not have wide variety of options. Air conditioners have high initial and running costs, which cannot be afforded by all the people in a developing country like India. Air coolers are relatively cheap, but provide unsatisfactory results; there is a need for developing a cheaper room cooling system. Conventional air conditioning is one of the major contributors of CFCs into the atmosphere. An alternative type of cooling, which does not expel CFCs is highly desirable as one important step in the correction of this problem. [1]So, this is why adiabatic cooling is environmentally friendly because it is a passive cooling method that does not expel CFCs. It is 100% fresh air-cooling which even helps to clean the air it cools. With the help of Evaporative Technology swamp coolers provide cooling at cheaper than central air or larger air conditioners.

The Air cooler may be define as the type of heat exchanger ,which lower the temperature of the surrounding up to the certain cooling there is no humidity control and no air purification system like in air conditioners .

- So the invention made the man invented the air cooler in the form of hand fan cooler ,the wetted grass mat where employed.
- In the evaporative process to cool the air ,since then evaporative process has been machined and various device has been developed
- Then the various research and developments in design and technology has been made and an electrically driven and pump type air cooler is made but the basic principle is same as that was in the older air cooler.
- So in our project we spent the time to modify the existing cooler by using peltier effect by considering the concept of electricity saving in cooler.

A multi- utility desert cooler [2,3] is one in which water cooling as well as cold storage systems are attached in

addition to the air cooling system. The average effectiveness was found to be 65.42% and a temperature range of 22-27₀ C was achieved. It can be used only in areas with high temperature and low relative humidity hence reducing its scope.

Macmanus [4], developed a clay evaporative cooler for the purpose of preservation of fruits and vegetables at a lower temperature and also to study the physical parameters such as cooling efficiency, cooling capacity, etc. in the system. The results showed that the evaporative cooler reduces the temperature up to 10₀ C and increases the relative humidity of incoming air for the storage chamber. The evaporative cooler was able to preserve freshly harvested tomatoes for about 19 days. It is observed that clay is a material which helps in evaporative cooling and has shown proven results.

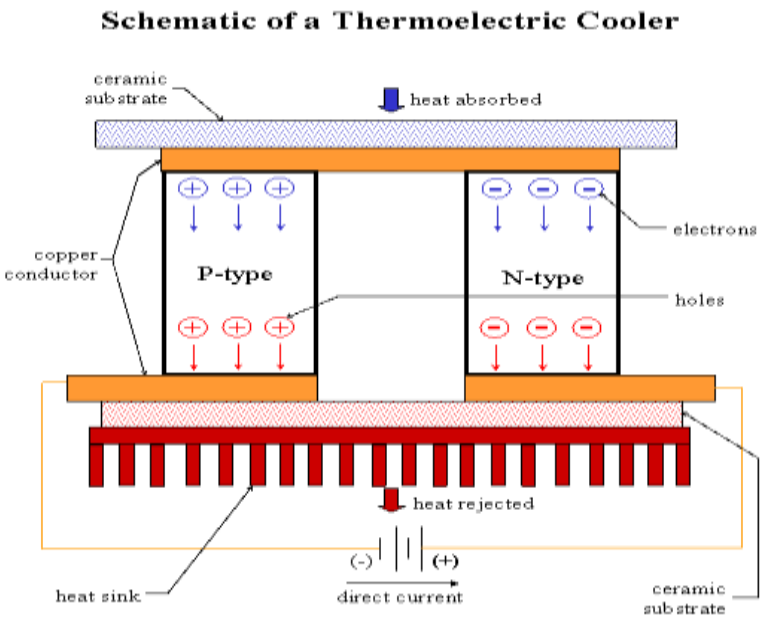
Hence, it is proposed to build an air cooler which provides better room cooling in addition to providing a cold storage box for refrigeration purpose at a cheap initial, running and maintenance costs which will meet the demands of a large section of the society who find it difficult to bear the hot temperatures.

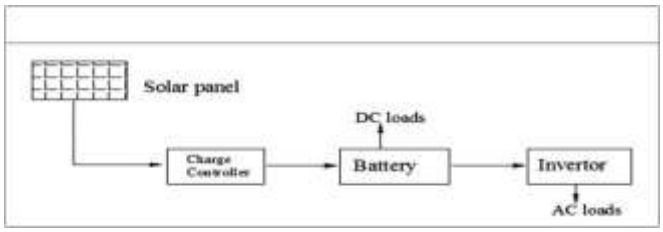
- This concept is driven by solar energy. Components involved in this concept are solar panel, battery, charge controller, battery, inverter, blower, ceramic slabs and cooling pads.

- Solar panel is employed to convert sun light into electrical energy by means of photovoltaic effect. The generated electrical energy is supplied to the battery for storage purpose through charge controller which prevents from power fluctuations.

- As AC blower is used for cooler, so need to convert DC load from the battery to AC load by the help of inverter. Inverter converts DC load to AC. Load, now AC power can be supplied to the blower.

- The water is surrounded by cooling cooling and Peltier element through which heat transfer occur between water and air, so the cool air enters into the room thus providing required thermal comfort conditions.





II. DESIGN MODEL AND COMPONENTS OF THE SYSTEM

The size and capacity of an air cooler and storage system is mostly determined by:

- The size of the room to be cooled by the system.
- The volume of items to be stored in the cold storage box.
- The temperature preferred inside the room to be cooled.

A) Parameters affecting the rate of cooling

As the cooling process occurs by evaporative cooling, the rate of cooling is dependent on a number of factors which are stated below..

- Atmospheric temperature.
- Atmospheric humidity.
- Temperature of the water supplied.
- Velocity of air.

In the above stated factors, though certain factors such as velocity of air, porosity of the mod pot can be controlled by the user, the rest are entirely dependent on the environment. These parameters affect the rate of cooling of the room and the cold storage box but they are independent of any internal factors and cannot be controlled.

The designs model in fig. 1shows the various components of the modified air cooler cum storage system.

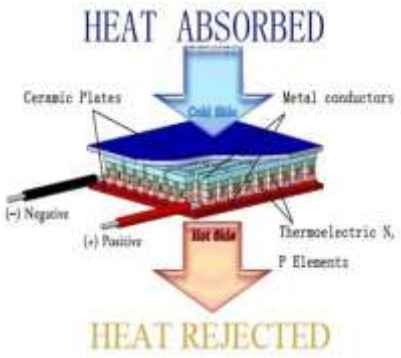
B) *Components of the System*

The main components of modified air cooler system are Lower tank,Pump,Cooling pad, Electrical fan, Vent system, condenser, Cold storage box with peltier and Connecting pipes.

C) Lower tank

The lower tank comprises of arrangement in which the inner tank is filled with water while the gap between the outer and inner pots is filled by sand slurry as shown fig. 2. This tank is filled with water and is pumped up to the upper tank by the help of a pump. After the completion of the cycle, the water comes back to the lower tank. The cooling process takes place by evaporative cooling. The cooling is based on the physics principle that when evaporation takes place, cooling occurs. This is because for evaporation to take place, the water needs to change into vapor or gas and this only happens when there is heat in the surroundings. So when the water absorbs heat, it evaporates and this makes the container or surroundings cooler. The earthen pitcher contains many pores or small holes. When water is poured into the tank, a small part of it exits through these pores and evaporates from the surface of the pot, thus making the tank (and remaining water) cooler than before. It is effective only when the outside temperature is high. Hence it is used only during summer and not during winter season.

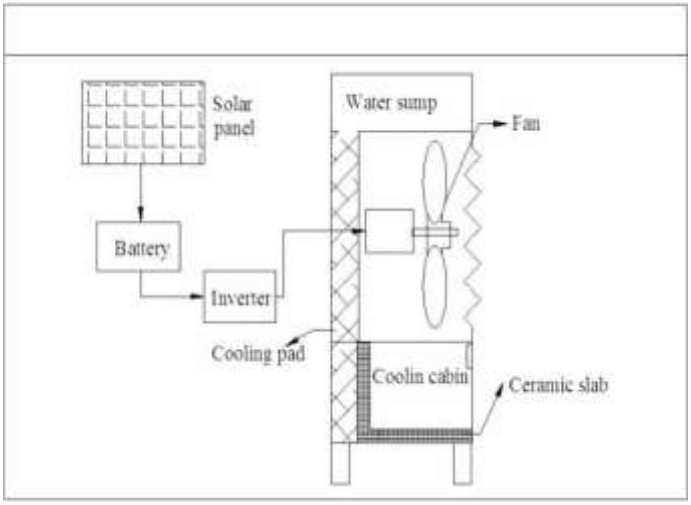
D)Peltier Element for cooling water



- **Peltier effect** is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material.
- This phenomenon can be useful when it is necessary to transfer heat from one medium to another on a small scale. The Peltier effect is one of three types of thermoelectric effect; the other two are the See-back effect and the Thomson effect.

III. WORKING METHODOLOGY

- This project mainly consist of two sections:



Solar Energy Conversion

- Solar energy conversion is done by using battery, inverter and charge controller. As sun light falls on solar panel, which converts into electrical energy by photoelectric effect. This electrical energy stored in battery in the form of chemical energy. Charge controller is employed in between solar panel and battery which prevents overcharging Figure
- Solar energy conversion process may protect against overvoltage which can reduce battery performance or lifespan, and may pose a safety risk. The stored energy directly can use for DC loads or else need to be converted AC (alternate current) by the help of inverter.

- **Condenser use**
- A condenser is a device or unit used to condense a substance from its gaseous to its liquid state, by cooling it. In so doing, the latent heat is given up by the substance and transferred to the surrounding environment.
- Instead of making direct downward flow towards tank water is flown throw the condenser so that cool water flow through condenser pipe and through outside atmospheric air, the air temperature coming from cooler decreases.

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- Instead of making direct downward flow towards tank water is flown throw the condenser so that cool water flow through condenser pipe and through outside atmospheric air, the air temperature coming from cooler decreases back to the lower tank. The components are connected to each other by the help of connecting pipes which are made of polymers to avoid heat losses. Fig. 4 shows the fabricated working model of the proposed system.

Figure. Condensor (heat exchanger)

When the system is switched on, the pump and the electrical fan start running as they are the only components utilizing power in the system. The water in the lower tank is pumped to the upper tank by the positive displacement pump. The water then reaches upper tank and it then flows into the cooling pad. The cooling pad absorbs the water particles coming from the upper tank. The surrounding air particles absorb the chillness of the water particles. A dehumidifier is placed next to the fan and it absorbs the moisture in the air and the air now has only low temperature and not moisture. The air is then flown in the required direction by the vent system. The vent system is used for passing the air in the required direction and not blindly into the room. On the other side, water also flows towards the cold storage box and flows around the hollow box. As the box is made of steel, the box gets chilled and it can be used for storing perishable items. The water then returns back to the lower tank and the cycle is repeated. By using this system, room cooling can be done effectively than a normal air cooler and cheaper than an air conditioner with addition to providing a storage system.

IV. RESULTS AND DISCUSSION

The experimentation is carried out to record observations in a 656 cubic feet.Properties and dimensions of the room considered for experimentation is

- The flooring is concrete.
- Two sides of the room are covered by concrete walls.
- Two sides of the room are covered with glass insulation.
- The ceiling is covered by thermocool layer.

S.NO	CONDITIONS	TEMPERATURE
1	Room Temperature	38
2	Temperature of water in earthen pot	35
3	Temperature inside peltier	31

Table 1: Initial conditions

S.NO	Time in minutes	Conventional air cooler (0C)	Modified air cooler (0C)
1	0	36	36
2	30	34	33
3	60	32	31
4	90	30	29
5	120	30	28
6	150	29	27
7	210	28	26
8	240	28	25
9	270	28	25

Table 2: Comparison of Room Temperature using Conventional Air Cooler and Modified Air Cooler

It is observed from table 2 that in five hours the room temperature decreases from 36°C to 28°C by using conventional air cooler, in last two hours the temperature of room remains constant at 28°C. While using modified air cooler the room temperature decreases up to 24° C, which is 4°C less than conventional desert cooler.

S.NO	Time in minutes	Conventional tank (°C)	Peltier system(°C)
1.	0	35	30
2.	30	30	29
3.	60	28	27
4.	90	27	26
5.	120	26	25

Table 3: Comparison of Water Temperature in Conventional peltier.

CONCLUSION AND SCOPE FOR FUTURE WORK

A. Conclusion

- The project carried out by us made an impressing task in the field of Cost of generation of power is very less so the source of power is free and available in plenty and then is no power interruptions. This project has also reduced the cost involved in the concern. Project has been designed to perform the entire requirement task which has also been provided.
- Our modified air cooler concept is more beneficial as compare to the ordinary air cooler. By studying this project we have achieved a clear knowledge of comfort cooling system for human by using non-conventional energy. This project would be fruitful in both domestic & industrial backgrounds. We also know about non-conventional energy sources and utilization.

B.Scope for Future Work

In this project, parameters such as room cooling and provision of cold storage box for storing perishable items were done. Optimization of the working parameters can be done in order to produce an effective and efficient system.

REFERENCES

[1] J.K..Jain and Hindoliya D.A, "Development and Testing of Regenerative Evaporative Cooler",International Journal of Engineering Trends and Technology, Vol.3, No. 6, Pp 694-697,2012.

[2] M.P.Poonia, A.Bhardwaj, Upender Pandel and A.S.Jethoo A.S, "Design and Development of Energy Efficient Multi-Utility Desert Cooler", Universal Journal of Environmental Research and Technology, Vol. 1 Pp 39-44, 2011.

[3]B.Chandrakant, Kothare and NitinB.Borkar, "Modified Desert Cooler", International Journal of Engineering and Technology, Vol.3, No.2, Pp 166-172, 2011.

[4] Ndukwu Macmanus Chinenye, "Development of Clay EvaporativeCoolerforFruitsand VegetablesPreservation",AgriculturalEngineering International: CIGR Journal Manuscript No.1781. Vol. 13, No.1, Pp 1-8, 2011.

[5] Farhan A. Khmamas, "Improving the environmental cooling for air-coolers by using the indirect-cooling method", ARPN Journal of Engineering and Applied Sciences, Vol. 5, No. 2, Pp 66-73, 2010.

[6] R.K.Kulkarni and S.P.S.Rajput, "Comparative performance of evaporative cooling pads of alternative materials", International Journal of Advanced Engineering Sciences and Technologies, Vol.10, No. 2, Pp 239–244, 2011.

[7] Sirelkhatim K. Abbouda and Emad A. Almuhanna, "Improvement of Evaporative Cooling System Efficiency in Greenhouses" International Journal of Latest Trends in Agriculture & Food Sciences, Vol. 2, No. 2, Pp 83-89, 2012.

[8] Hussain Yousif Mohammed and Abduljaleel Hussain Abd, "Optimum Design of Evaporative Air Cooler", Journal of Kerbala University, Vol. 10, No.2, Pp 287-299, 2011.