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# Experimental Study of Thermoelectric Cooling through Combined Peltier Cooling Module and Forced Air Convectionthrough Clay Pot

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Abstract: Cooling through evaporation is an ancient effective method of lowering temperature. The simple clay pot refrigerator is ideally suited for preserving vegetarian food and water in hot and dry climates. The refrigeration takes place by evaporation through the porous pot material. Due to the latent heat of vaporization temperature drops inside the pot of the water and the air is cooledby circulation through the copper tubes inserted in pot in coil form to transfer theheat from low temperature to high temperature by forced circulation method through blower fan. The extra cooling effect for instant cooling is provided by combine thermometric cooling device peltier module the thermal analysis is detail discussed here.

Keywords: vaporization, Refrigeration, Temperature, Porous, Free and forced convection

# I. INTRODUCTION

Cooling through evaporation is an ancient and effective method of lowering temperature. Both plants and animals use this method to lower their temperature. Trees, through the method of Eva transpiration remain cooler than their environment. The principle underlying evaporative cooling is conversion of sensible heat to latent heat. The warm and dry outdoor air is forced through porous wall or wetted pads that are replenished with waterfrom cooler's reservoir. Due to low humidity of theincoming air some of the water gets evaporated.

Some of the sensible heat of the air is transferred towater and become latent by evaporating some of water. The latent heat follows the water vapour anddiffuses into the air. Evaporation causes a drop in the dry-bulb temperature and a rise in the relative humidity of the air. But this is overcome by heat transfer through copper coil which is inserted in clay pot. But cooling through this method has limitation which is overcome by combine cooling through thermoelectric cooling device which cools the chamber fast which cannot be achieve by cooling through forced convection by with the help of clay potwater temperature .

# 1.1 Objectives

The current research is focusing on a technology which is able to cool the chamber or require space effectively with no carbon emission. In this project the cooling is done by evapouration through clay pot due to it porous structure which enables it to release latent heatof vapourization

This project also include thermoelectric peltier module which has 2 side one is of cooling nature and other is of hot nature we uses cool side of peltier device which has various advantages it can drop the temperature to very low degree, it doesnot have any moving parts is like VRCS system

# **II. LITERATURE REVIEW**

Overview of Peltier Cooling Technology: Peltier cooling devices, also known as thermoelectric coolers, offer a compact, efficient, and environmentally friendly cooling solution. These devices operate based on the Peltier effect, where an electric current is applied to create a temperature difference between two electrical junctions. The heat is absorbed at one junction and dissipated at the other, resulting in rapid and precise cooling without the need for refrigerants ormoving parts.

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489

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Clay Pot Evaporative Cooling Technology: Claypot evaporative cooling is an ancient technique that has been used for centuries to cool water in hot climates. The principle involves water seeping through the porous walls of a clay pot, where it evaporates, causing a drop in temperature inside the pot.

Integration of Copper Tubes for Enhanced Cooling: Recent studies have explored the integration of copper tubes into clay pot evaporative cooling systems to enhance cooling efficiency. The copper tubes act as heat exchangers, transferring heat from the air to the water inside the clay pot, thereby further reducing the temperature of the circulated air.

# Future prospects

- This project can be use to cool air for humancomfort can be uses as a air conditioner
- It can be use to keep the vegetables and otherrefrigeration require product fresh for a long period of time
- This type of cooling is used in green datacenters and various industrial
- environments with almost no power use, no carbon production and no water used but that which exists within the closed system.
- Used to heat and cool a single house, singlebusiness, or an entire community (college campus, neighborhood, etc.)

# III. WORKING

The conventional cooling systems are usednow a days are requires the refrigerant whose phase change takes place in heat exchanging and compressor are required for the compression of the refrigerant.

The compressor required more power and space. The refrigerant is also not eco- friendly and increases the global warming and the major cause of ozone layer depletion.

The objectives of this study is to develop aworking thermoelectric refrigerator to coola volume 20L cabin that utilizes the of two stages primary cooling and secondary cooling which consists of cooling by means of copper tubes/pipe in low temperature zones to cool and maintain a selected temperature range of 5 0C to 25 0C.

Renewable energy source like, solar energy is used in this project. Solar panel of 12v 10 w used to extract the solar energy and convert into electric energy.

This electric energy is stored into battery of 12v, 8 Amp. Whole system is operate with this power stored energy.

Also external power source added advantage for emergency situation when their is very less energy available min battery.

The control unit also provide to operate each function. When any products is insertinto cooling chamber unit. Try to close the door present at front of cabin. The overall cabin is insulated with aluminium sheet, tomaintain and spread the cooling temperature throughout the are inside cabin/chamber.

To mention the temperature inside the container. Thermoelectric unit (with aluminium block, aluminium sink and exhaustfan) is covered both side of container. And try to cool down the internal temperature. Also high speed fan are added to internal unit of container for more efficiency in cooing.



Total 2 thermoelectric system is used to cover the aprox. 2 litre capacity of chamber. Inside this chamber high speed fan with led lights gives proper refrigerator feelings. Outside the chamber temperature sensor is placed which measure the drop down temperature of coolingchamber.

This type of solar powered portable refrigeration machine gives more advantage for poor people in India.

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The primary cooling is done by passing the thecopper tubes/pipe line from low temperature water reservoirs as such water pot the air istransmitted to secondary cooling device wherethe temperature is further reduce by using the heat conductive property of copper efficiency of heat transfer is increased for cooling purpose.

In secondary cooling the pipeline which conduct the chilled air to the cooling chamberis passed underground through the soil as the temperature below the soil is very less as upto8-10°c with helps in creating a low temperature for keeping agriculture based products fresh.

The air is circulated by the means of suction an in the pipe lines

#### Advantages

We believe that thermoelectric cooling offers anumber of advantages over traditional refrigeration methods, as:

- No moving parts, eliminating vibration, noise, and problems of wear. •
- No Freon's or other liquid or gaseousrefrigerants required,
- High reliabity and durability. •
- Compact size and light weighted,
- Relatively low cost and high effectiveness, •
- Eco-friendly C-pentane, CFC free insulation
- Highly economical for farmer •
- Low power consumption as per compared toconventional refrigeration system

#### Disadvantages

- C.O.P. is less as compared to conventional refrigeration system.
- Very low temperature cannot be attain bythis system

# Applications

- For cooling vegetable for keeping them freshfor long time for farmer ease •
- Cooling of the home/domestic purpose •
- Cooling of electronic hardware •
- Cooling of a test set-up, in a lab ٠
- In provincial India, in summers when there is no power, sun based solar energy conversion and utilization •
- Can be conveyed along when voyagingoutside •



# **IV. CONCLUSION**

#### Fig. Ambient and ambient temperature versustime.

When the TEC connected to the power supply, the current flow across a junction between two different wires of the TEC. This caused the heat to transfer from one side of the TEC surface to another due to the Pottier effect. Due to a suddentemperature drop to the TEC surface temperature, the heat from the cooler was conducted from a cold surface to 2581-9429 Copyright to IJARSCT DOI: 10.48175/568 491 IJARSCT

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the hot surface. As can be seen infigure 11, the cold surface temperature, Tc had dropped evenlower temperature than the inner air temperature, Tint.

Before reaching the steady state temperature, the TEC surface temperature plummeted to its lowest point of 8.9°C before reaching a steady state at approximately 9.5°C for more than 3 hours.









This study consisted of modelling a theoretical background of the Peltier cooler to predict its performance. The performance that had been assessed including the minimum achievable cold temperature, the rate of heat removal from the refrigerated space and coefficient of the performance of the cooler. For the theoretical modelling, the temperature difference between the internal space of the cooler box and the ambient were firstly assumed. The assumed value was used in the simulation to predict the hot and cold temperatures of the Peltier cell surfaces. This value is essential in predicting the Peltier cooler performance such as the coefficient of performance (COP) and theheat removal from the mini cooler.

To use better performance passive heat sinks for heat dissipation such as heat pipeheat sink.

To use active cooling liquid heat sink forremoving external heat from the Peltier module.

To use high-performance Peltier cell

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