

“Cooling Enhancement of MITTICOOL Clay Refrigerator with Thermoelectric Peltier Cooler”

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Abstract: At present time global warming is major problem for our environment .And it is going to no return stage at this stage the temperature is impossible to control and it going high and high. So to stop this stage with use of CFC free refrigeration System. Thermoelectric peltier Cooler is provided CFC free refrigeration and there is absence of compressor, so it is noise free refrigeration. MITTICOOL clay refrigerator is natural refrigerator made with clay which able to reduce up to 8 degree temperature than ambient temperature. But rate of Cooling is very slow. To increase rate of Cooling we can use thermoelectric peltier Cooler in it so we can get high rate of Cooling. So with combination of MITTICOOL clay refrigerator and thermoelectric peltier Cooler we can get high cooling effect without producing CFC ,noise and plastic pollution in environmental.

Keywords: - Peltier, MITTICOOL, CFC free, Thermoelectric, Cooling

Introduction

The conventional cooling systems are used now a days are requires the refrigerant whose phase compared to conventional refrigerators. Thus, they are used in niche applications where their unique advantages outweigh their low efficiency. Although some large-scale applications have been considered (on submarines and surface vessels), Peltier coolers are generally used in applications where small size is needed and the cooling demands are not too great, such as for cooling electronic components. 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 mini Eco-friendly refrigerator is based on the PELTIER EFFECT and a thermoelectric device called Peltier device is used for the cooling purpose. In the MEF-Refrigerator there is no need of compressor and refrigerant. Semiconductor

thermoelectric coolers (also known as Peltier coolers) off temperature control ($< \pm 0.1$ °C) can be achieved with Peltier coolers. However, their efficiency is low.

Problem Statement

At present time global warming is major problem for our environment .And it is going to no return stage at this stage the temperature is impossible to control and it going high and high. So to stop this stage with use of CFC free refrigeration System.

Objective of work

From problem statement the objective of work is to selecting the CFC free refrigeration system. Thermoelectric peltier Cooler is provided CFC free refrigeration. MITTICOOL clay refrigerator is natural refrigerator made with clay which able to reduce upto 8 degree temperature than ambient temperature. But rate of Cooling is very slow. To increase rate of Cooling we can use thermoelectric peltier Cooler in it so we can get high rate of Cooling. So with combination of MITTICOOL clay refrigerator and thermoelectric

peltier Cooler we can get high cooling effect without producing CFC in environmental.

Literature Review

[1] C. Hermes, J. Barbosa, "Thermodynamic comparison of Peltier, Stirling, and vapor compression portable coolers"

This paper compares the thermodynamic performance of four small-capacity portable coolers that employ different cooling technologies: thermoelectric, Stirling, and vapor compression using two different compressors (reciprocating and linear). In this work, author compared performance parameters using a thermodynamic approach that splits the overall 2nd law efficiency into two terms, namely, the internal and external efficiencies. In doing so, the internal irreversibility. Compression machines, Joule heating and heat conduction in the thermoelectric devices of the Peltier cooler) were separated from the heat exchanger losses (external irreversibility), allowing the comparison between different refrigeration technologies with respect to the same thermodynamic baseline.

[2] J.G. Vian, D. Astrain, "Development of a heat exchanger for the cold side of a thermoelectric module".

Authors have developed a heat exchanger for the cold side of Peltier pellets in thermoelectric refrigeration, based on the principle of a thermosyphon with phase change and capillary action. This device improved the thermal resistance between the cold side of a Peltier pellet and the refrigerated ambient by 37% (from 0.513 of the finned heat sink, to 0.323 K/W). It also has been experimentally proved that the COP of thermoelectric refrigerators can be improved up to 32% (from 0.297 to 0.393) by incorporating the developed device. Authors performed experimental study of the COP increase obtained in a thermoelectric refrigerator if TPM is used.

[3] Prabodh Sai Dutt "An Investigative Review on Recent Developments in Refrigeration by Evaporative Cooling"

In this research paper researchers compare different evaporation Colling system like MITTICOOL clay refrigerator, zeer pot etc and review that The MITTICOOL " concept provides idea towards developing models that are as aesthetically good looking as the commercial refrigerators. Improvisation of the design to accommodate more food and water might prove helpful to the farmers. Increasing the efficiency by testing different materials instead of clay might provide an opportunity to replace most of the electrically drive domestic refrigerators.

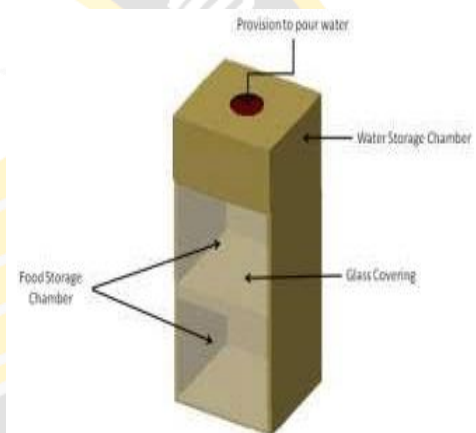


Figure 1 Diagram of MITTICOOL Fridge

[4] Shyam Patidar "THERMOELECTRIC REFRIGERATION USING PELTIER EFFEC T"

In this research paper researchers state that TER system is a novel refrigeration system which will be a better alternative for conventional refrigeration system. The research and development work carried out by different researchers on TER system has been thoroughly reviewed in this paper. This paper also concludes that, to achieve better COP & temperature control we can combine TER with other refrigeration systems. For example combining VCR & TER systems reduces the energy consumption, gives high COP & good temperature control within the refrigerated area. Hencebit is better to have such hybrid systems & devices to reduce total energy consumption."

[5] Ajtkumar N. Nikam, Dr. J. A. Hole“A Review on use of Peltier Effects”

In this research paper researchers review on use of peltier module and state that thermoelectric cooling is emerging as a truly viable method that can be advantageous in the handling of certain small-to-medium applications. As the efficiency and effectiveness of thermoelectric cooling steadily increases, the benefits that it provides including self-contained, solid-state construction that eliminates the need for refrigerants or connections to chilled water supplies, superior flexibility and reduced maintenance costs through higher reliability will increase as well.

[6] Manoj Kumar Rawat, Prasanta Kumar Sen, Himadri Chattopadhyay, Subhasis Neogi “Developmental and Experimental Study of Solar Powered Thermoelectric Refrigeration System”

In this research paper researchers developed an experimental prototype of thermoelectric refrigeration system working on solar photo voltaic cells generated DC voltage. The developed experimental prototype having a refrigeration space of 1liter capacity is refrigerated by using four numbers of Peltier module.

[7] R. Chein, Y. Chen, “Performances of thermoelectric cooler integrated with microchannel heat sinks”

In this study, experimental and theoretical studies on thermoelectric cooler (TEC) performance for cooling a refrigerated object (water in a tank) were performed. Microchannel Heat sinks fabricated with etched silicon wafers were employed on the TEC hot side to dissipate the heat.

[8]Nilesh Totala, P. Desai, Rahul K N Singh, Debarshi, gangopadhyay,“Study and Fabrication of Thermoelectric Air Cooling and Heating System”

In this research paper researchers make one thermoelectric air cooling system with peltier module this Thermoelectric Air cooling & heating system was designed and built which can be used

for personal cooling & heating. TECs were used for achieving the cooling with a DC power supply through external power supply. It had been shown from testing results that the cooling system is capable of cooling & heating the air when re circulating the air with the help of blower. TEC cooling designed was able to cool an ambient air temperature from 32.5°C to 22.1°C.

[9]R. S. Chavan, Manoj Dhawde "REVIEW ON PERFORMANCE AND ANALYSIS OF THERMOELECTRIC COOLING IN VARIOUS APPLICATIONS“

In this research paper researchers analysis thermoelectric cooling and state that thermoelectric cooling added a new dimension to cooling. It has major impact over conventional cooling system. It is compact in size, no frictional element are present, no coolant is required and weight of the system is low. This works on peltier effect. Bismuth Telluride is the most common thermoelectric material used in TEC system. Improved cooling performance, ability to work for a long period of time , it can use in space and low operating cost make TEC a contender.

[10] Gaurav Maradwar,” Fabrication And Analysis Of Problems In Thermoelectric Refrigerator”

The two main issues in thermoelectric refrigeration are the development of new materials with stronger Peltier effects and the application of these materials to real engineering problems such as refrigeration and control of process heat. The former issue is primarily the domain of physicists and materials scientists who test a large number of materials looking for crystalline structures which combine high electrical conductivity with low thermal conductivity as well as a strong thermoelectric characteristic. The latter issue is of greatest concern to mechanical engineering where problems such as heat transfer between the module and cheap manufacture of modules are of concern. For refrigeration, unlike air conditioning, the power consumption is relatively small, typically 50 Watts

which means that the number of modules and their cost is also small. This means that the main issue for refrigeration is heat transfer between the module and its external environment. The level of interest in these engineering problems is intensifying as the efforts of physicists and materials scientists produce thermoelectric materials with usefully high levels of performance.

Summary

For low volume of rapid cooling Peltier cooler only one best option for CFC free refrigeration. MITTICOOL is one of the best option in natural evaporative cooling with it attractive design with

combination of evaporative and thermoelectric cooling we can make best Eco-friendly refrigerator which not produce CFC as well as Plastic pollution. so it protect ozone layer a reduce global warming.

Experimental setup

The In this project we are going to make door of MITTICOOL with help of Glass, Thermocol, and Clay and also develop combination of MITTICOOL clay refrigerator and thermoelectric peltier Cooler fit peltier Cooler with heat sink and cooling fan in lower chamber of MITTICOOL clay refrigerator.

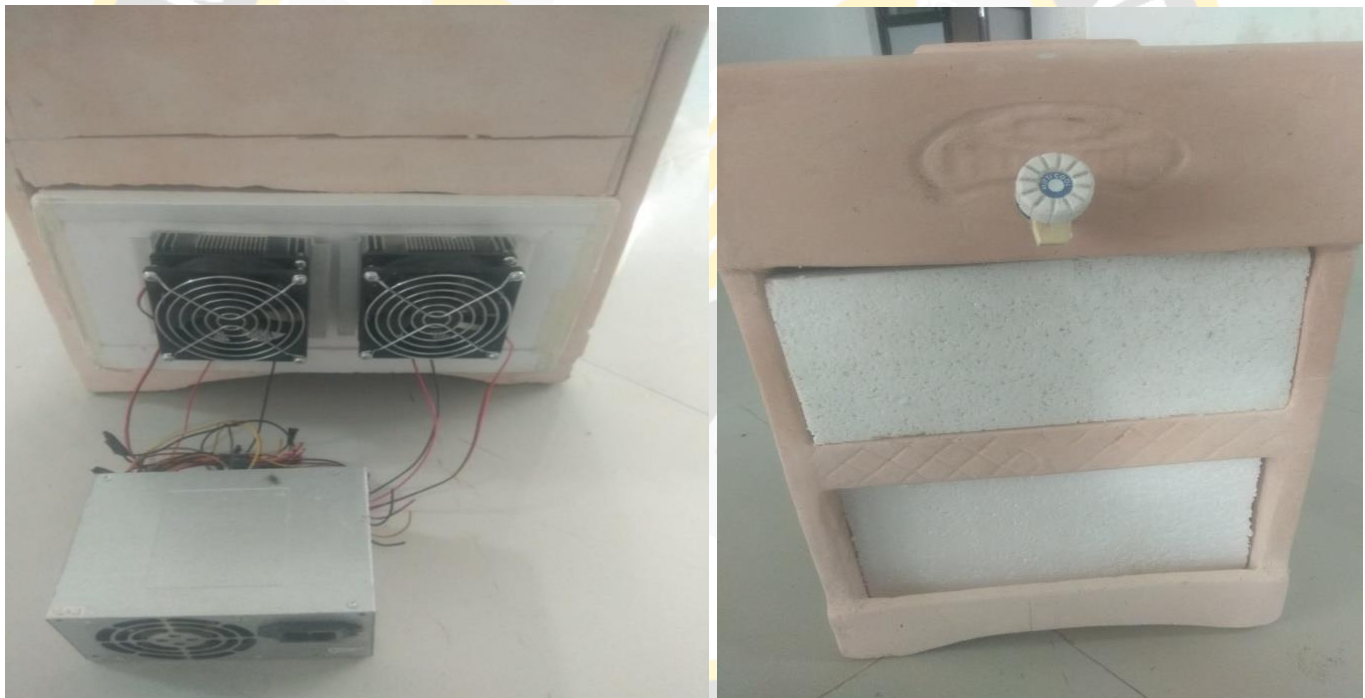


Figure 2 Back & Front side of MITTICOOL



Figure 3 Lower Chamber of MITTICOOL measuring instrument

A thermocouple is a device consisting of two different conductors that produce a voltage, proportional to a temperature difference, between either ends of the two conductors. The joined end is called the sensing junction or hot junction and the terminated end is called the reference junction or cold junction. The temperature at the reference junction is called reference temperature and is always maintained constant. When the sensing junction and the reference junction are at different

temperatures, a potential difference is obtained and this causes a flow of current in the circuit. The thermoelectric voltage produced is due to the different binding energies of the electrons to the metal ions. This voltage depends on the metals themselves, and in addition on the temperature. The thermal voltage is produced only because of the closed circuit between the two metals. This phenomenon is called “See back Effect”.

Table 1 Observation table of experimental setup

Time	Glass door	Thermocol door	Clay door	Peltier Cooler
10:00	35	35	35	34
11:00	34	33	33	12
12:00	33	32	32	9
13:00	33	31	31	8
14:00	32	30	30	8
15:00	31	29	29	7
16:00	30	29	28	7
17:00	29	28	28	7
18:00	28	28	27	7

Result & Discussion

Figure 4 shows the Temperature Time plot in MITTICOOL Refrigerator with Three different

doors and with peltier. The Figure 4 shows that clay door give better cooling than glass door and thermocol door.

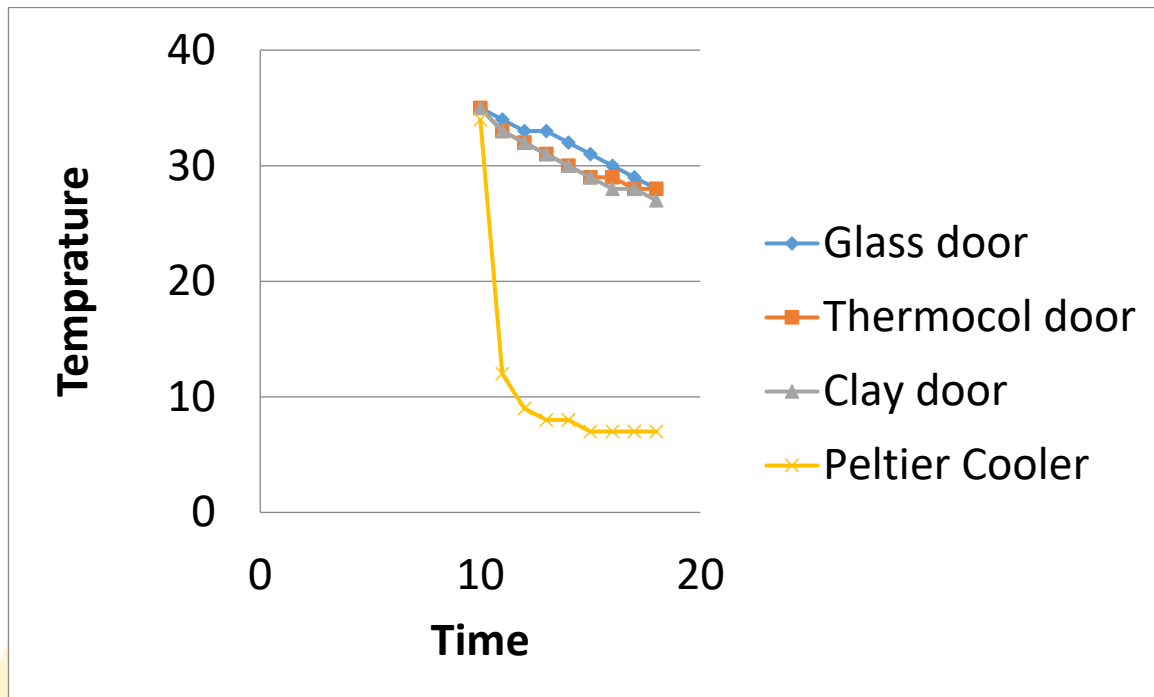


Figure 4 Temperature with respect to time in MITTICOOL

Figure 4 also shows that with help of Peltier cooler we get very Rapid Cooling rate. Within 2 hour we get 7 Degree centigrade temperature. So result show with help of clay door and peltier we get very rapid cooling.

Conclusion

In this experiment we use three different types of door material and also use peltier cooler in it. From result it has been observed that clay door give good rate of cooling then thermocol and glass door. And with help of two peltier we get rapid cooling Up to 7 degree Celsius.

Future scope

From this study it has been observed that Peltier is very good eco-friendly cooler with rapid rate of cooling. If we increase number of peltier then we get more cooling rate. We can also make ice rapidly if we use peltier. We can directly connect peltier with solar because it use dc power supply.

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