

Thermoelectric Air Conditioning

Mr. Parag Singhal¹, Tarun Chaudhary², Shardul Kumar Vijay²,
Tauheed Akhtar², Vaibhav², Ravin Singh²

¹Associate professor, ²Student

^{1,2}Mechanical Engineering, ABES Engineering College, Ghaziabad, Uttar Pradesh, India

How to cite this paper: Mr. Parag Singhal | Tarun Chaudhary | Shardul Kumar Vijay | Tauheed Akhtar | Vaibhav | Ravin Singh "Thermoelectric Air Conditioning" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-3, April 2019, pp.1728-1730, URL: <https://www.ijtsrd.com/papers/ijtsrd23509.pdf>



IJTSRD23509

ABSTRACT

We know that the present air-conditioning system produces cooling effect by refrigerants like Freon, Ammonia. Using this refrigerants can get maximum output but one of the major disadvantages is harmful gas emission and global warming. This problem can be overcome by using thermoelectric modules (Peltier effect) air-conditioner and their by protecting the environment. The present paper deals with the study of Thermoelectric air conditioner using different modules is discuss Thermoelectric cooling systems have advantages over conventional cooling devices, such as compact in size, light in weight, high reliability. High reliability as there is no moving parts.

Copyright © 2019 by author(s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



INTRODUCTION

Air conditioning is used for human comfort in terms of humidity and temperature. There are ways to producing cooling effect by like vapour compression and vapour absorption air condition. These type of air conditioners are producing cooling effect by using refrigerants like Freon and ammonia etc. It gives maximum output but one of the disadvantages is producing harmful gases to the atmosphere. The harmful gases are chloro fluoro carbon and some other gases are present.

The present Air Conditioning System produces cooling effect by using Chloro Fluoro Carbons like Freon, Ammonia, etc., Which damages the environment. We can save the environment by using thermoelectric modules (Peltier Modules) Air Conditioners. These thermoelectric modules are completely eco-friendly system. These type of air conditioners have wide range of applications.

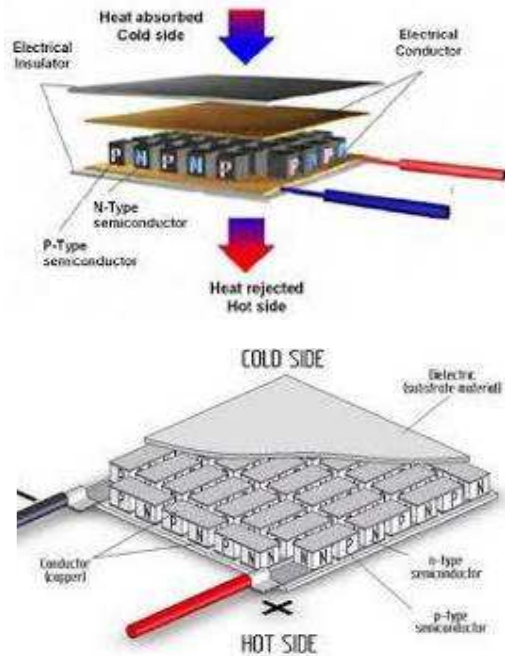
Thermoelectric cooling, commonly referred to as cooling technology using thermoelectric coolers (TECs), has advantages of high reliability, no mechanical moving parts, compact in size and light in weight, and no working fluid. Also it has an advantage that it can be powered by direct current (DC) electric sources, When a voltage or DC current is applied to two dissimilar conductors. Air conditioning is used for removing heat from a room or other applications.

There are many ways used for cooling effect by like vapour compression and vapour absorption air condition. These air conditioners uses refrigerants like Freon and ammonia etc for cooling. It gives maximum output but, one of the disadvantage is producing harmful gases to the atmosphere. The harmful gases are chloro fluoro carbon and some other gases are present.

Working Principle

The basis of the thermoelectric effect is that conduction electrons in different materials have different average energy levels. In a semiconductor the electrons in the conduction band have a higher average energy than the electrons in the conduction band of a metal. Thus, in the junction of a suitable semiconductor and a metal an electron current, due to an applied field, flowing from the metal to the semiconductor, will transfer thermal energy from the metal to the semiconductor. On the other end of the semiconductor where the electron flow leaves to enter a metal again the thermal energy will be released to the metal. This is a greatly simplified explanation of the thermoelectric or Peltier effect. There are many other factors which influence the operation of a thermoelectric junction. The rate of heat pumped through the material per unit of current flowing is called the Peltier-coefficient, x . Rate of heat flow, Q

Thermoelectric Module



Thermoelectric Coolers are an electrical module, which produces a temperature difference with current flow. The emergence of the temperature difference is depending on the Peltier effect designated after Jean Peltier. The thermoelectric module is a heat pump and has similar function as a refrigerator. It gets along however without mechanically small construction units (pump, compressor) and without cooling fluids. The heat flow can be turned by reversal of the direction of current. Thermoelectric cooling provides an alternative solution to the common compressor and absorber cooler. Thermoelectric coolers are used especially if small cooling power is required up to 500 W.

Our goal is to define the new HVAC system using thermoelectric couple which shall overcome all the drawback of current HVAC system. If this system comes in present HVAC system, then revolution will occur in the automobile. With rising population and pollution at an alarming rate this system has come to rescue as these are environment friendly and compact. Conventional compressor run cooling equipment have more limitations related to energy efficiency and Chloro-Fluro Carbon (CFC) refrigerants use. Both these factors indirectly point to the impending scenario of global warming. As most of the electricity generation relies on the coal power plants, which add greenhouse gases to the atmosphere is the more cause of global warming. Although researches are going on, best alternatives for the CFC refrigerants is still on the hunt. So instead of using conventional air conditioning systems, other products which can efficiently cool a person are to be planned. By using other efficient cooling device, we can save the electricity bills as well as control the greenhouse gases that are currently released into the surrounding atmosphere. Although thermoelectric property was discovered about two centuries ago thermoelectric device save only been commercialized during current years. The applications of thermoelectric varies from small refrigerator.

Need of Thermoelectric Air Conditioner

Now a day, an automobile is a necessity for everybody. For a far or near travelling people need car regard to the safety,

environment and most important comfort. Due to these reasons, many vehicles are equipped with heating, ventilating and air conditioning system. In vehicle without HVAC system no one feel comfortable so, HVAC together with part of people life. This HVAC system is more efficient and reliable but it has some limitations. It has been seen during the previous two decades that the ozone(O3) layer is slowly destroyed because of the refrigerant like CFC and HFC used for the refrigeration and air conditioning. The refrigerant used is HFC's which are leaked into the atmosphere. When they reach to ozone(O3) layer they act on O3 -molecules and the layer of O3 is destroyed.

It includes demerits like, the compressor is driven by the crankshaft of the engine. So, it consumes about 5 to10% power of the engine. This consequently reduces mileage of the vehicle. Therefore it decreases the pickup of the vehicle. The cost of present HVAC system is more; it may vary depending upon price and model of vehicle. Maintenance and repairing cost of this system is more. Each component of HVAC is very costly. This system uses very large space in engine compartment and dashboard. If any of the component fails to perform well then, the whole system either will not function properly or will not function at all. Instead of this, today's electronically and computer controlled HVAC system has sensors. Due to high power requirement of an engine, the AC system will not start and person will need to wait for the starting of the HVAC system.

Components of TEAC

1. Heat sink / Thermal fin
2. Thermoelectric Module
3. Water block
4. Radiators
5. Fan

Heat sink / Thermal fin



These fins comprises of metal i.e. of aluminum. Thermal gradient value is increased & hence increases the See beck voltage generated by TEAC. This heat is used in cold side of Peltier module through which room air passes and it cools down and again circulated into the room.

Thermoelectric Module

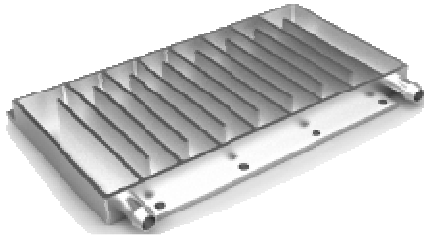


Thermoelectric Module (TEC 12715) is used where TEC stands for Thermoelectric cooler 127 is the number of NPN semiconductors used which are connected in series

(Electrically) and in parallel (thermally), 15 stands for max ampere it can consume.

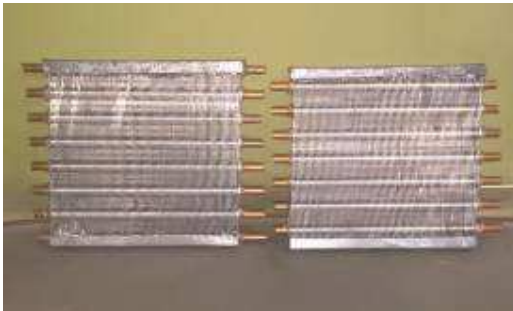
4 of these modules are used to cool the heat sink attached on the cold side of modules.

Water block



An Aluminum water block is used through which water flows and thus heat transfer from peltier to water is done much efficiently. Dimensions of water block are (9x9x1.5)cm, which is attached on the hot side of TEC's to lower down the temperature of hot side so that more temperature difference can be achieved.

Radiators



3 Radiators are used in the hot side of Air Conditioner to radiate heat transferred to water through TEC's to surroundings.

Fan



2 Fans are used in this Air Conditioner.

The fan with high RPM is used in the hot side of Air Conditioner, and the slow one in the cold side.

Literature Review

1. Manoj Kumar presented an experimental study of novel potential green refrigeration and air conditioning technology. They are analyzing the cause and affect of an existing air condition system. Thermoelectric cooling provides a promising alternative R&AC technology due to their distinct advantages. The available literature shows that thermoelectric cooling systems are generally only around 5-15% as efficient compared to 40-60% achieved by the conventional compression cooling system .

2. Shen, Xiao investigated a novel thermoelectric radiant conditioning system (TE-RAC). The system employs thermoelectric modules as radiant panels for indoor cooling, as well as for space heating by easily reversing the input

current. Based on the analysis of a commercial thermoelectric module they have obtained a maximum cooling COP (coefficient of performance) of 1.77 when applying an electric current of 1.2 A and maintaining cold side temperature at 20°C.

3. Manoj and Walke¹⁰ conducted an experimental study of thermoelectric air cooling for cars. They are trying to overcome these demerits by replacing the existing HVAC system with newly emerging thermoelectric couple or cooler which works on Peltier and Seebeck effect.

4. Yadav and Mehta¹¹ presented combined experimental and theoretical study of thermoelectric materials and application. The present study develops an optimization design method for thermoelectric refrigerator. This device is fabricated by combining the standard n- and p-channel solid-state thermoelectric cooler with a two-element device inserted into each of the two channels to eliminate the solid-state thermal conductivity.

5. Maneewan conducted an experimental investigation of thermal comfort study of compact thermoelectric air conditioner. In this paper analyses the cooling performance of compact thermoelectric air-conditioner. TEC1-12708 type thermoelectric modules used for heating and cooling application. The compact TE air conditioners COP (coefficient of performance) was calculated to its optimum parameters. Then analyses the COP (coefficient of performance) with respect to time and calculated cop at various considerations.

Conclusion

The literature about the investigation of Thermoelectric air conditioner using different modules has been thoroughly reviewed. From the above review of the pertinent literature presented, it can be inferred that thermoelectric technology using different modules used for cooling as well as heating application has considerable attention. Many researchers try to improve the COP of the thermoelectric air-conditioner using different material. Thermoelectric coolers to be practical and competitive with more traditional forms of technology, the thermoelectric devices must reach a comparable level of efficiency at converting between thermal and electric energy.

References

- [1] Manoj Kumar, Chattopadhyay and Neoga, "A review on developments of thermoelectric refrigeration and air conditioning systems", International Journal of Emerging Technology and Advanced Engineering, pp.no. 362-367, 2013.
- [2] Shen, Xiao, Chen & Wang, "Investigation of a novel "thermoelectric radiant air-conditioning system"., Journal of Energy and Buildings, pp.no: 59, 123-132, 2012.
- [3] Manoj S. & Walke, "Thermoelectric Air Cooling For Cars", International Journal of Engineering Science and Technology, pp.no: 40(5), 2381-2394, 2011.
- [4] Yadav and Nirves. Review on "Thermoelectric materials and applications", International Journal for Scientific Research & Development, 1,413-417, 2013.
- [5] Maneewan. Tipsaenpromand Lertsatitthanakorn. "Thermal comfort study of a compact thermoelectric air conditioner", Journal of electronic materials, 39(9), 1659-1664, 2010.