Refrigeration Application Using Peltier Module

[1]Prof. Pawan Kamdi, [2]Prof. Y. R. Ikhe

Assistant Professor
Electrical Engineering Department
DMIETR, Sawangi(m), Wardha

Abstract **This paper presents the performance of solar refrigeration system by using peltiermodule .Thermoelectric modules are the key elements in this refrigerator for providing the thermoelectric cooling. This projects system of peltier module, heat sink, charge controller, solar panel, battery, micro–controller kit, wooden box etc. Power consumption is one of the major issues in today's general life. But semiconductor is a great solution of this power consumption. If we success to use the semiconductor in well manner then we can reduce power consumptions. Peltier module is one of the best solutions for this. In this project peltier module is used where at one gets cooled and other side become hot and rejects heat to the environment with the help of fans for producing cooling effect this means that cooling is done without use of greenhouse gaseous. Which would ultimately reduce the global warming which is usually caused by conventional refrigeration system? The supply are used both ac and dc supply and system will be cooled at 9^0c and heat will be produced till 85^0c. Due to use of charge controller, system gets efficient output. Advantages of our system over conventional system are beneficial. This system having no moving parts, due to which system became rugged and reliable .they can be extremely compact much more than compressor. It is portable and economical system. Dead bodies can preserved at -70^0C for few days. This is the portable refrigeration system which can be used in hospitals to stores medicines any drugs or injections also we can install this system in ambulance. By using peltier module in our daily life to save electricity or power consumption.**

Keywords **- Peltier module, Peltier cooling, refrigeration, heat sinks, charge controller, battery**

I. Introduction

Energy is a vital for the progress and development of a nation's economy. Energy shortages and variable power availability is responsible for society's advancement. The
Systems are designed such that there will be no adverse Effect on the environment. Energy saving and low environmental impact should be the primary targets for the system designers and producers. Conventional refrigeration consumes enormous Energy and uses Chlorofluorocarbons which causes ozone Layer depletion. Solar refrigeration has been getting more and more attention. Solar refrigeration is one of the alternative technologies that use solar power in combination with peltier effect. Solar energy is the natural source of energy. It is continuously available on the earth surface during the day time. As it is natural source of energy it doesn't produce any harmful byproducts. Recently, solar energy has received interest as in attractive energy source for cooling systems, Especially in places where electricity is expensive or in short supply. The solar energy is available in most areas and represents an important driving source of thermal energy systems. With the use of solar energy, usage of conventional energy sources and its peaks demand will be reduced .This project consist of components peltier module, charge controller, solar panel ,battery, microcontroller kit, heat sinks, temperature sensor.

Peltier Module -

Peltier is semiconductor module, the module material chosen is bismuth telluride. The peltier is module which is cooling and heating system work at a time. It is work as dc supply, when dc current flows through the system then got the two sides, one is cooling side and other is heating side. Cooling side is used for refrigeration system and other side is removed from the system by the used for heat sink. The cold side also made of Aluminum is in contact with the cold side of a thermoelectric module, when the positive and negative module leads are connected to the respective positive and negative terminals of a D.C. power source, it will be absorb by the module's cold side. Fig(1) shows thecooling effect of single stage peltier.

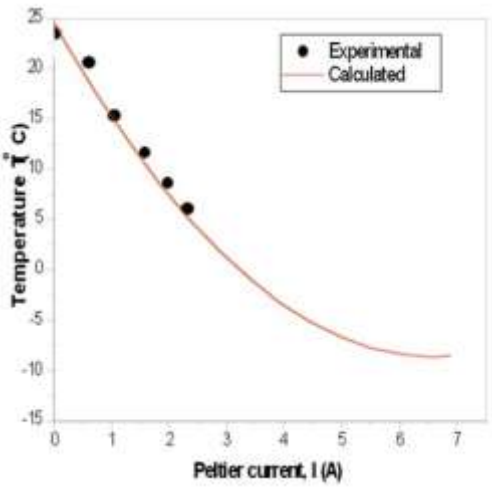

Fig. 1 cooling effect of a single stage peltier

Working -

The thermoelectric module consist of pairs P-type and N –type semiconductor thermo element forming thermocouple which are connected electrically in series and thermally in parallel. The module are considered to be highly reliable component due to their solid state ,for most application they

will provide long, trouble free service, in cooling application, an electric current is supplied to the module and the result is that one side of the module becomes cold and other side hot.
Amount of heat to be absorbed at the TEC's cold surface.This can be termed as heat.It is represented as Q_c and unit is watt.

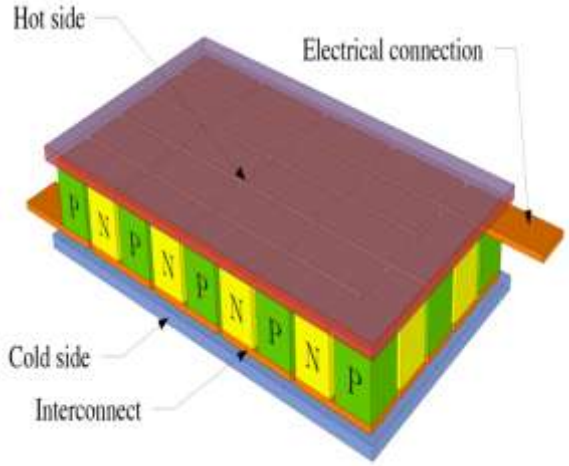

Fig. 2 Working principle of thermoelectric module

- Cold side Temperature (T_c)
- Hot side Temperature (T_h)
- Operating temperature difference

(ΔT),which is the temprature difference between T_h and T_c.

Cold side temperature -
If the object to be cooled is in direct contact with cold surface of the TEC's,the required temprature can be considered the temperature of the cold side of TEC.In this project the object is air,which has to be cooled when passing through aluminium heat sink,the aim is be cooled the air flowing through the heat sink ,when this type of system is employed the cold side temperature of theTEC is needed to severaltime coolder than ultimate desire of temp of the air.

Hot Sode Tempreture -
The hot side temperature (T_h) is mainly based on the two factor.first parameter is the temperature of the ambient air in enviorment to which the heat is been rejected and second factor is the efficency of heat sink this is between hot side of TEC on ambient.

Tempreture diffrence –
The two temperature T_C and T_h, and difference between them are ΔT is very important factor,the following equation shows actual ΔT.

$$\Delta T = T_h - T_c$$

Actual ΔT is a difference between hot and cold side of TEC.

II. Block Diagram

As per study, we will make the wooden box and provide insulation of aluminium foil and. Thermocol. We will install peltier module on heat sink and also test it. We will implement the micro controller circuit and program for the control unit.We will test solar panel and charge controller circuit and assemble the entire component systematically. The block diagram is shown below of Solar refrigeration system by using peltier fig 3.

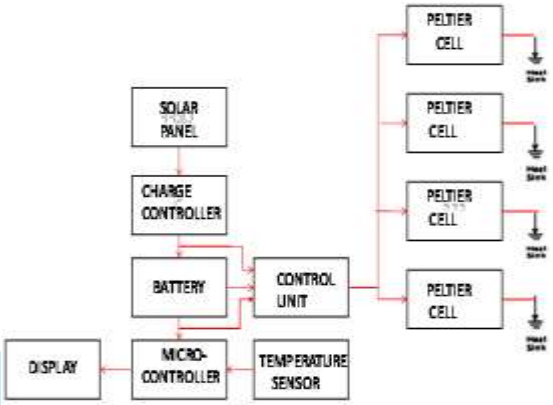

Fig. 3 Block diagram

III. Work Done

Selected the peltier module of TEC 12706 MODEL and other components for refrigeration system. Designed solar charge controller to avoid fluctuation of sunrays on the solar panel and preventing the battery from discharging. for displaying internal and external temperature micro-controller circuit is designed. Wooden box is composed and provided the insulation of thermocole, copper, aluminium foil paper. Peltier and heat sink is embed in the box. Assembling of contol unit, solar panel and the wooden box to form the refrigeration system.

IV. Project Design

V.Result

The outer temperature of system is 33ºc and the minimum inner temperature achieved was recorded by system is shown in following table

SR.NO	TIME (IN MIN)	TEMPERATURE (ºC)
1	Initial	33.2
2	25	24.93
3	30	22.97
4	45	10.75
5	55	8.31
6	60	7.33

VI. Conclusion and Future scope:

Conclusion: The device can act as coolers, heat pump, power generators, or thermal energy sensors and are used in almost all field such as military, aerospace, instrument, biology, medicine, industrial or commercial product. The major challenge faced in TE cooling is lower cop especially in large capacity system. However as energy cost are elevating and environment regulations regarding the manufacture and release of CFC's have become more firm with time, the scope of TE effect has revived, especially in developing countries or the third world where the energy is not surplus.

Future Scope: In the coming years thermoelectricity has lot of potential to create energy saving and effective solutions for the industry an commercial as well. Thermoelectric chilling of beverage can be done at the farm level to inhibit any enzymatic or microbial changing quality of the beverage. Research in the field thermo chemistry and the experimentation with different material is required to improve coefficient of power of thermoelectric system. Insulation is done properly then thermal conductivity is reduced and it can be use as portable system in vehicles, etc.

References

1. Sanchit kumar gupta, "Enhancing the performance of solar refrigeration system", *International journal of research and science (IJSR)*

2. Prof. Pushkarny B.H.1, Divyesh Patel2, Akshay Parulkar3, Hitesh Rai4, Nadeem Khan5 , "Solar Refrigeration Using Peltier Effect", International journal of research in aeronautical and mechanical engineering , Issn (online): 2321-3051, Vol.4 Issue 2, February 2016.

3. Onoroh Franchis,Chukuneke Jeremiah Lekwuwa, Itoje Harrison John,"Performance Evaluation Of a Thermoelectric Refrigerator", International journal of Engineering and innovative Technology,(IJEIT)

4. Saket Kumar1, Ashutosh Gupta2, Gaurav Yadav3, HemendHU Pal SingK4 , "Peltier Module for Refrigeration and Heating using Embedded System ", *IEEE 2015 International Conference on Recent Developments in Control, Automation and Power Engineering (RDCAPE).*

5. Reinhard Radermacher, Bao Yang, Integrating Alternative and Conventional Cooling Technologies, ASHRAE Journal, October.

6. Jonathan Winkler, Potential Benefits of Thermoelectric Element Used With Air-Cooled Heat Exchangers, International Refrigeration and Air Conditioning Conference.

7. Christian J L and Jadar R Barbosa Jr (2011), "Thermodynamic Comparison of Peltier, Stirling, and Vapor Compression Portable Coolers", Applied Energy, Vol. 9, pp. 51-58.

8. "Solar Refrigeration Using the Peltier Effect", by .C.Swart, School of Electrical Engineering at the Cape Technicon

9. Novel control method for compensation of voltage sags and swells using dynamic voltage restorer by yogesh ikhe.