

## Solar Refrigeration System by using Peltier Module

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**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 consist of peltiermodule, heatsink, chargecontroller, solarpanel, 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 solution 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<sup>o</sup>c and heat will be produced till 85<sup>o</sup>c.due to use of charge controller, system get efficient output. Due to this 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<sup>o</sup>C for few days. 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.

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### INTRODUCTION

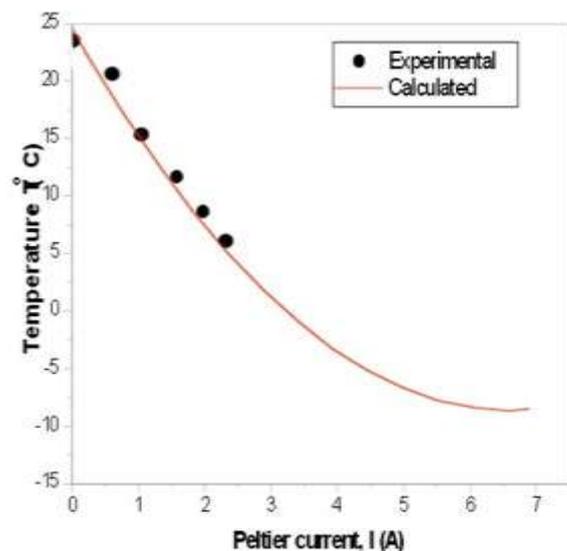
Energy is a vital for the progress and development of a nation’s economy. Energy shortages and variable power availability is responsible for society’s advancement. The Systems are designed such that there will be no adverse Effect on the environment.Energy saving and low environmental impact should 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, heatsinks, 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

### SOLAR PANEL:-

The direct conversion of solar energy is carried out into electrical energy by conversion of light or other electromagnetic radiation into electricity.

### CHARGE CONTROLLER:-

A charge controller is an essential part of solar refrigeration system that charge battery. Its purpose is to keep a battery properly fed and safe for the long term. The basic function of a controller are quite simple. Whenever the sunrays fall on a solar panel then there is a fluctuation of solar rays on solar panel. To avoid the fluctuation of sunrays on solar panel, we use charge controller in solar refrigeration system. Also, charge controller prevent battery overcharge and electrical overload. We are using MPPT(Maximum Power Point Tracking) base solar charger in our solar refrigeration system.

### BATTERY

The battery is an electrochemical converting chemical energy into electrical energy. The main purpose of the battery is to provide a supply of current for operating the cranking motor and other electrical units.

Specification,

1. Voltage 12v
2. Current 6 A

In this paper, they innovatively assembled the refrigeration system by using few principles that is, Terracotta and Peltier effect. They made the cabinet of Terracotta which is the type of clay and provide natural cooling inside the cabinet. They have also used Peltier module which works on principle of thermoelectric cooling for cooling effect in their refrigeration system. [1]

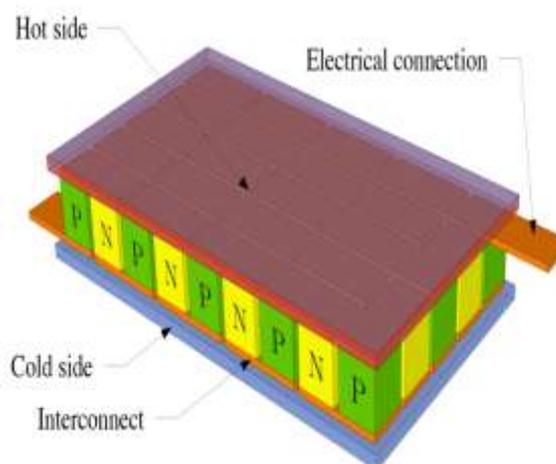
In this paper, cooling effect is made by using Thermoelectric device that is Peltier. As in conventional refrigeration system, the release of CFCs have become more firm with time which causes pollution in the environment. Also, in conventional refrigeration system, the energy used is surplus. To overcome this disadvantages, they have designed Thermoelectric refrigeration system. The minimum temperature achieved in their system was found to be 15°C for cooling and maximum temperature was 65°C for heating. [2]

In this paper, they have added new dimension for cooling purpose with reduction of temperature using Thermoelectric effect to enhance the performance of solar refrigeration system. So, the solar refrigeration by using Peltier effect is designed and simulated by using MATLAB to maintain the temperature of enclosure at 4°C. Also, they have plotted a graph of coefficient of performance versus current and coefficient of performance is depend on temperature difference between the hot and cold side of the Peltier module and they have obtained a temperature difference of 20°C.[3]

### 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.



Fig(2):- Working principle of thermoelectric module

- Cold side Temperature ( $T_c$ )
- Hot side Temperature ( $T_h$ )
- Operating temperature difference ( $\Delta T$ ), which is the temperature difference between  $T_h$  and  $T_c$ .

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.

### Cold side temperature:-

If the object to be cooled is in direct contact with cold surface of the TEC's, the required temperature 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 to be cooled the air flowing through the heat sink, when this type of system is employed the cold side temperature of the TEC is needed to several times cooler than ultimate desire of temp of the air.

### HOT SIDE TEMPERATURE:-

The hot side temperature ( $T_h$ ) is mainly based on the two factors. First parameter is the temperature of the ambient air in environment to which the heat is being rejected and second factor is the efficiency of heat sink this is between hot side of TEC on ambient

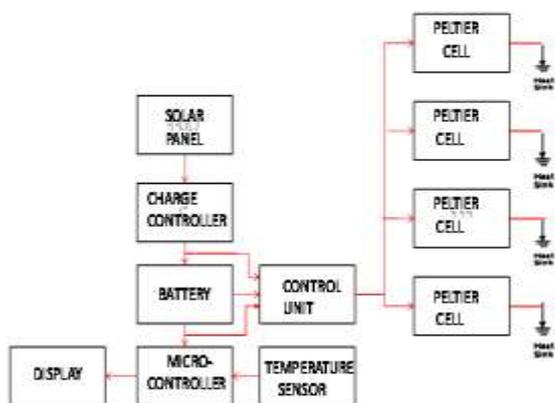
### TEMPERATURE DIFFERENCE:-

The two temperatures  $T_c$  and  $T_h$ , and difference between them are  $\Delta T$ .  $\Delta T$  is a very important factor, the following equation shows actual  $\Delta T$ .

$$\Delta T = T_h - T_c$$

Actual  $\Delta T$  is a difference between hot and cold side of TEC.

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 all the component systematically. The block diagram is shown below of Solar refrigeration system by using peltier fig(3).



Fig(3) Block diagram

### Solar Panel:-

The direct conversion of solar energy is carried out into electrical energy by conversion of light or other electromagnetic radiation into electricity. The dimensions of the panel are- Length – 48.5 cm, Width – 35 cm.

### Charge Controller

A charge controller is an essential part of solar refrigeration system that charge battery. Its purpose is to keep a battery properly fed and safe for the long term. The basic functions of a controller are quite simple. Whenever the sunrays fall on a solar panel then there is a fluctuation of solar rays on solar panel. To avoid the fluctuation of sunrays on solar panel, we use charge controller in solar refrigeration system. Also, charge controller prevents battery overcharge and electrical overload. We are using MPPT(Maximum Power Point Tracking) base solar charger in our solar refrigeration system

### Battery

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### Temperature sensor

Temperature sensor is measurement devices that determine temperature by sensing corresponding physical characteristics. Temperature sensor is device, typically, solar refrigerator system that provides for temperature measurement through an electrical signal.

### 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.

### Heat sink

The heat sink usually made of aluminum, is in contact with the hot side of a thermoelectric module. When the positive and negative module leads are connected to the respective positive and negative terminals of a Direct Current (D.C) power source, heat will be rejected by the module's hot side, the heat sink expedites the removal of heat. Heat sink typically is intermediates stages in the heat removal process whereby heat flows into a heat sink and then is transferred to an external medium. Common heat sinks include free convection, forced convection and fluid cooled, depending on the size of the refrigerator.

### Micro-controller

We are using ATmega328 microcontroller in our solar refrigeration system, which is used to display the temperature through LCD. The ATmega328 is a single chip microcontroller created by Atmel in the megaAVR family.

### Conclusion

There are several different types of cooling devices available to remove the heat from industrial enclosures as well as medical enclosures, but as the technology advances, 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. It can use in ambulance for storing medical equipments, can use in remote area for storing

medicines, etc. Blood plasma and antibiotics are manufactured using a method called freeze drying.

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