



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

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Fabrication & Analysis of Solar Refrigeration Using Peliter Effect

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ABSTRACT: In the recent years, we have many problem such as energy crises and environment degradation due to the increasing CO₂ emission and ozone layer depletion has become the primarily concern to both developed and developing countries. Our project utilizes the solar energy for its operation. Air cooler using thermoelectric module is going to be one of the most cost effective, clean and environment friendly system. Cooling is the process of heat-removal from a space in order to bring it to a lower temperature than surrounding temperature. In this context, my seminar topic, “**Peltier cooling module**” which works on thermoelectric air cooling, aims to provide cooling by using thermoelectric effects rather than the more prevalent conventional methods like vapour compression cycle or the vapour absorption cycle. There are three types of thermoelectric effect.

KEYWORDS: Thermoelectric effect, Peltier cooling module, Solar refrigeration system.

I. INTRODUCTION

Conventional cooling systems such as those used in Air Conditioners utilize a compressor and a working fluid to transfer heat. Thermal energy is absorbed and released as working fluid undergoes expansion and compression and changes phase from liquid to vapour and back, respectively. Semiconductor thermoelectric coolers (also known as Peltier coolers) offer Several advantages over conventional systems. They are entirely solid-state devices, with no moving parts; this makes them rugged, reliable, and quiet. They use no ozone depleting chlorofluorocarbons, potentially offering a more environmentally responsible alternative to conventional refrigeration. They can be extremely compact, much more so than compressor-based systems. Precise temperature control ($< \pm 18$ °C) can be achieved with Peltier coolers. However, their efficiency is low 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. The objectives of this study are design and develop a working thermoelectric air cooler, cooling of air that utilizes the Peltier effect to cool down and maintain a selected temperature from 5 °C to 25 °C. The copper tube is wound on the front of the table fan which helps in convection between water in the tube and flowing air. The design requirement, options available and the final design of thermoelectric air cooler for application are presented.

II. RELATED WORK

On by reviewing the literatures on solar operated thermoelectric refrigeration of the various researchers, the literatures here described as: [1] **Sujith G. et al.(2016)** In this paper author design and fabricated the Thermoelectrical Refrigeration to cool a volume of 40L using principle of Peltier effect to cool and maintain temperature range of 5°C to 25°C and the project is used only for light heat load to lower its temperature to particular temperature. One of the advantage of this project is it takes low power to drive the refrigerator. [2] **Bharat M. Jibhakteet al.(2016)** The study show that a Thermoelectric Refrigeration model is design and fabricated in place of compressor and it is based on principle of Peltier effect to maintain effectiveness of both heating and cooling side also the simulation is done to on thermoelectric refrigeration to maintain it at 40°C. The designed is environmental friendly also it has various applications in medical and pharmaceutical equipments. [3] **Sivakumar.N.et al.(2018)** In the literature the author designed the Thermoelectric Refrigeration in place of prime movers, compressor or any type of refrigerant as this

designed is applicable in such areas where the electricity not available and also environmental friendly as CFC, CO₂ etc. produce in other refrigeration system. [4] **Mr. Swapnil B. Patondet al.(2015)** In this research a thermoelectric module is designed to analysis the heating and cooling system by using solar energy and which is based on peltier effect. This system is different from other refrigeration system where heating and cooling is done with the help of mechanical devices and by using refrigerants. Experimental study is done for small scale solar operated thermoelectric heating and cooling, the graph is plotted from obtained results from experiment for different metals, fruits & water to analyse the heating and cooling rates in various modes. [5] **D. Rajaniet al.(2018)** In the literature the author fabricated a prototype of solar operated thermo electric cooling system based on peltier effect and its working on solar photo voltage cell generated DC voltage. Through the experiments the performance parameter (heat absorption, energy supply and coefficient of friction) are analysed the result show that the COP of the system increases with time interval.

III.OBJECTIVE

In this proposed work, the main aim is to develop a refrigeration system with a capacity of 40L of cooling chamber. It is necessary to design a system capable of maintaining the temperature of the materials between 10⁰ C to 15⁰ C for a long duration. Since the system has to be used in remote areas where power is scarce, alternative sources of energy like battery or solar power has to be incorporated in the design. Moreover the system is meant for outdoor use which makes better insulation and radiation control mandatory. In order to meet worse scenario, even though the system is to designed for maintaining a fixed chamber temperature throughout the operational period, the design should be such that it can adaptable for refrigerating the chamber from ambient temperature to the required temperature. The main objective of the heating & cooling system service is to be suitable for use by the people who live in the remote areas of country where load shading is a major problem.

IV. COMPONENT DETAILS

4.1 Thermoelectric Module thermoelectric coolers from II-VI act as a solid-state heat pump. Each features an array of alternating n- and p- type semiconductors. The semiconductors of different type have complementary Peltier coefficients. The array of elements is soldered between two ceramic plates, electrically in series and thermally in parallel. Solid solutions of bismuth telluride, antimony telluride, and bismuth selenide are the preferred materials for Peltier effect devices because they provide the best performance from 180 to 400 K and can be made both n-type and p-type.

4.2 Solar Cell A monocrystalline solar panel is a solar panel comprising monocrystalline solar cells. These cells are made from a cylindrical silicon ingot grown from a single crystal of silicon of high purity in the same way as a semiconductor. The cylindrical ingot is sliced into wafers forming cells. To maximize the utility of the cells, the circular wafers are wire cut to an octagonal shaped wafer. These cells have a unique look because of the octagonal shape. Monocrystalline solar cells are among the three types of materials that exhibit photovoltaic properties. The other two are polycrystalline solar cells and amorphous or thin film solar panels. Monocrystalline solar panels have features considered better than the other two types of panels.

4.3 Battery A battery works on the oxidation and reduction reaction of an electrolyte with metals. When two dissimilar metallic substances, called electrode, are placed in a diluted electrolyte, oxidation and reduction reaction take place in the electrodes respectively depending upon the electron affinity of the metal of the electrodes. As a result of the oxidation reaction, one electrode gets negatively charged called cathode and due to the reduction reaction, another electrode gets positively charged called anode. The cathode forms the negative terminal whereas anode forms the positive terminal of a battery. To understand the **basic principle of battery** properly, first, we should have some basic concept of electrolytes and electrons affinity.

V.CONSTRUCTION DESIGN AND WORKING PRINCIPLE

5.1 Construction Design Generally we see that refrigeration process uses electric energy which is not available at most of the remote places in our country .we know that sun energy is available everywhere which also green energy and renewable energy source. We also save electric energy here.From last century till now refrigeration has been one of the most important factors of our daily life. The current tendency of the world is to look at renewable energy resources as a source of energy. This is done for the following two reasons; firstly, the lower quality of life due to air pollution; and, secondly, due to the pressure of the ever increasing world population puts on our natural energy resources. From these two facts comes the realization that the natural energy resources available will not last in definitely. The basic idea is

implementation of photovoltaic driven refrigerating system powered from direct current source or solar panel (when needed) with a battery bank. The Seebeck, Peltier and Thomson effects, together with several other phenomena, form the basis of functional thermoelectric modules. Thermoelectric Refrigeration aims at providing cooling effect by using thermoelectric effects rather than the more prevalent conventional methods like those using the 'vapour compression cycle' or the 'gas compression cycle'.

5.2 Working Principle Solar panel gets charged due to sunlight. Load battery gets charged from solar panel. Electrical energy from battery is given to the peltier plate in fridge. Temperature sensor sense the temperature and analog signal is converted to digital through ADC. The microcontroller gets the ADC output and the temperature is shown on the LCD screen . At an electronic device which contain its own processing power, memory and inputs output port to interact with other electronic devices. The battery with built-in inverter voltage and current used in this study has 12 V and 12 A. The output for four ports is 12V DC with 14 V Converter. Recent battery based inverters provide sufficient DC to AC power conversion. Connecting the inverter/charger to an AC power source releases whole fresh field of application flexibility. The generators have been the most common backup source for off-grid and enhanced the system performance and flexibility and used in high power, infrequent loads. During a stretch of cloudy weather, it can simultaneously power loads and assist in recharging the batteries. The generator can decrease the cost of a PV-based system by allowing it to size for average annual insolation instead of low winter daylight hour. If the batteries or inverter fail, a generator can serve as a stand-alone backup to the inverter system.



VI. CONCLUSION

The Thermal Electric devices can act as coolers, heat pumps, power generators, or thermal energy sensors and are used in almost all the fields such as military, aerospace, instrument, biology, medicine, industrial or commercial products. The major challenge faced in Thermal electric cooling is lower COP especially in large capacity systems. However, as the energy costs are elevating and environmental regulations regarding the manufacture and release of CFCs have become more firm with time, the scope of TE effect has revived, especially in the developing countries or the third world where the energy is not surplus. TE chilling of beverage can be done at the farm level to inhibit any enzymatic or microbial change in quality of the beverage. Research in the field of thermoelectricity and experimentation with different materials is required to improve the COP of the TE cooler. In the coming years thermoelectricity has a lot of potential to create energy saving and effective solutions for the industry and commercially as well. The minimum temperature achieved was found to be 15°C for cooling.

REFERENCES

- [1] Sujith G, Antony Varghese, "Design and Fabrication of Thermoelectric Refrigerator with Thermosiphon System" International Journal of Scientific Engineering and Applied Science (IJSEAS) –Volume-2, Issue-4, April 2016 ISSN: 2395-3470.
- [2] Bharat M. Jibhakate, Jhankar Nikose, "Fabrication of Solar Operated Thermoelectric Refrigerator cum Oven -a Review" International Journal for Research in Technological Studies | Vol. 3, Issue 4, March 2016 | ISSN(online): 2348-1439.
- [3] Sivakumar N, Agathiyan V, "Fabrication Solar Refrigeration System by Peltier Effect" International Journal of Advance Research and Innovative Ideas in Education, Vol-4 Issue-4 2018, ISSN(O)-2395-4396.
- [4] Swapnil B. Patond, Priti G. Bhadake, "Experimental Analysis of Solar Operated Thermo-Electric Heating and Cooling System" International Journal of Engineering Trends and Technology (IJETT) –Volume 20 Number 3 –Feb 2015, ISSN-2231-5381.



- [5] D. Rajani, Dr. B. Chandra Mohan Reddy, "Fabrication and Experimental Analysis of Solar based ThermoElectric Cooling System" International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES) Impact Factor: 5.22 (SJIF-2017), Volume 4, Issue 8, August-2018., e-ISSN: 2455-2585.
- [6] Abhijith Raju, Ajeesh J, "Development of Portable Solar Thermoelectric Refrigerator" International Journal of April-2016 426 ISSN 2229-5518.



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