

Design and Fabrication of Mini Solar Refrigerator

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Abstract— In Today's world global warming is being increasing year by year. There are many reasons like pollution, deforestation, water contamination, etc...In coming year, This projects system consist of peltier module, heat sink, charge controller, solar panel battery, micro –controller kit, wooden box etc. 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

Keywords- Cooling fan, medicine refrigerator, solar plates, peltier etc.

1. INTRODUCTION

The Basis for Considering Solar Energy

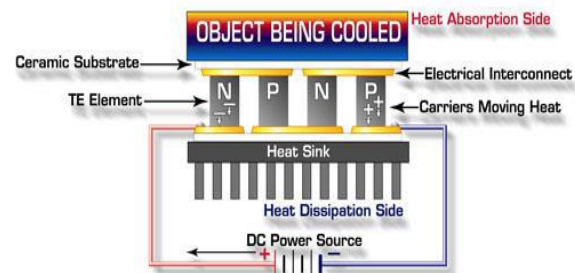
There are several important reasons for considering solar energy as an energy resource to meet the needs of developing countries. First, most the countries called developing are in or adjacent to the tropics and have good solar radiation available. Secondly, energy is a critical need of these countries but they do not have widely distributed readily available supplies of conventional energy resources. Thirdly, most of the developing countries are characterized by arid climates, dispersed and inaccessible populations and a lack of investment capital and are thus faced with practically insuperable obstacles to the provision of energy by conventional means, for example, by electrification. In contrast to this solar energy is readily available and is already distributed to the potential users. Fourthly, because of the diffuse nature of solar energy the developments all over the world have been in smaller units which fit well into the pattern of rural economics.

It uses no moving parts except for some fans, employs no fluids, and do not require bulky piping and mechanical compressors used in vapors-cycle cooling systems. Such sturdiness favors thermoelectric cooling over conventional refrigeration in certain situations. The compact size and weight requirements, as well as portability in the design, rule out the use of conventional refrigeration.

II. THERMO ELECTRIC MODULE

Although Peltier effect was discovered more than 150 years ago, thermoelectric devices have only been applied commercially during recent decades. Lately, a dramatic increase in the application of TE solutions in optoelectronic devices has been observed, such as diode lasers, photo

detectors, solid-state pumped lasers, charge-coupled devices (CCDs) and others. The thermoelectric module consists of thermocouple formed by pairs of P-type and N-type semiconductor thermo element which are electrically connected in series configuration and thermally connected in parallel configuration. Due to their solid state construction the modules are considered to be highly reliable. For most application they will provide long, trouble free service. For cooling application, an electrical current supply is given to the module, heat is transferred from one side to the other, and the result is that the module will become cooler at one side and hotter at the other side

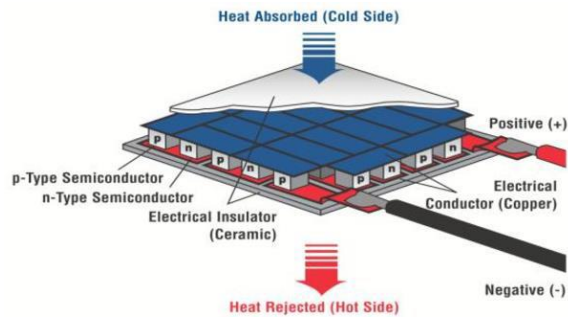


2.1 THERMOELECTRIC MODULE WORKING

Thermoelectric refrigerator works on the PELTIER effect that The peltier - see back effect, or thermoelectric effect, is the direct conversion of thermal differentials to electric voltage and vice versa. The Peltier-see back effect and Thomson effect are reversal of one another, joule heating cannot be reversible under the laws of thermodynamics.

III. DESIGN OF THERMO ELECTRIC REFRIGERATOR PROJECT OBJECTIVES

In this proposed work, the main aim is to develop a refrigeration system with a capacity of 4L of cooling chamber. It is necessary to design a system capable of maintaining the temperature of the materials between 3 °C to 23 °C



3.1 THERMOELECTRIC MODULE

Thermoelectric cooling uses the Peltier effect to create a heat flux between the junction of two different types of material. A Peltier cooler, heater or thermoelectric heat sink is a solid-state active heat sink which transfer heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current assembly

IV. EXPERIMENTAL SETUP

The following figure represents the block diagram of solar refrigerator Solar panel or solar cell which converts light energy into electrical energy is composed of P-N junctions, where electric current is produced due to the transfer of electrons. During day time the solar plate collects the light and converts into electricity and this current can be stored in the battery.

The current stored in the battery is only used in the absence of sunlight. And when there is abundant of sunlight the solar plate is directly connected to the refrigerator. The capacity of the battery is 12V and it stores energy which is required in the absence of sunlight.

The ADC which is used to convert the analog or electrical signals from the battery into digital signals. The digital signals are displayed on the LCD. And this LCD displays the maximum voltage present in the battery. The mini refrigerator which has peltier plate inside it acts as a cooling device. The peltier plate is made up of P-N junctions produce cooling effect on one side and heating effect on other side of the plate. The peltier plate works on peltier effect "when current is passed through a junction of two different metals, the heat is either evolved or absorbed at the junction" this is known as peltier effect. A dual mode switch is placed between the battery and the refrigerator, by reversing the polarity we can produce heating or cooling effect inside the refrigerator. i.e., peltier plate can be used as a heating device or cooling device just by reversing the polarity.

V MINI REFRIGERATOR

The mini refrigerator which is used for the storage of medicines in the flood affected areas has a dual mode battery which can be used for both heating and cooling purposes.

- Cools a beverage from 5V USB Power
- Stylized as a mini fridge

- Holds one can
- Internal LED light
- USB powered
- Weight: 1 kg

5.1 SOLAR PANEL

5.1.1 SPECIFICATIONS

- Dimensions 45X30 cm.
- Capacity: 5V
- Type: photo voltaic
- 10 watts

5.2 PELTIER PLATE

5.2.1 SPECIFICATIONS

- Type: TEC1-12726
- 400W
- 12V
- Pellets: 16
- I_{max} (A): 20
- Dimensions: 50 x 50 x 3.65mm (2 x 2 x 0.15")
- Fully sealed for protection against moisture.

5.3 LEAD ACID BATTERY

5.3.1 SPECIFICATIONS

- Sealed and maintenance free operation
- Non-Spill able construction design
- 12V 7.5Ah sealed lead acid battery
- high quality and reliability

5.4 ADC (ANALOG TO DIGITAL CONVERTER)

An analog to digital converter is a device which converts the readings of a physical quantity into a digital number that represents the quantity's amplitude. In this the result is a sequence of digital values that have converted a continuous-time and continuous-amplitude analog signal to a discrete-time and discrete-amplitude digital signal.

5.5 LCD DISPLAY

LCD is also known as liquid crystal display. A liquid crystal display(LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. LCD's are available to display arbitrary images or fixed images which can be displayed or hidden, such as prefet words, digits and seven-segment displays as in a digital clock.

VI WORKING PROCEDURE

6.1 SOLAR PANEL

Solar radiations which are emitted by the solar energy are absorbed by the solar panel. Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large

semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect.

Solar energy comes from the sunshine. The sun has constant thermonuclear explosions due to the fact that hydrogen atoms are bonded together with helium atoms. Energy brought on by this process that travels to the surface of the earth is known as radiation. Sun power panels convert radiation into electrical energy which can be stored in batteries for later use. Solar panels help to harvest electricity from the sun so that it can be converted into usable energy that is utilized in everyday activities.

A solar panel that has an efficient photovoltaic cell 1/5m within diameter creates approximately several amps at two volts. Many solar panels will not perform and also other solar panels because of atmospheric interference. Some your own solar panels may get direct sunlight all day long while other may just get partial sunlight. Also, solar panels may lose efficiency over the years due to overheating and physical use. The quality of power a unit yields is directly influenced by the quality of the solar panel. The types of materials utilized, the types of technology utilized and the quantity of time the solar panel has been functioning all factor into how efficient the solar panel will be. The main concern for purchasing a solar panel is the dollars/watt ratio.

The photovoltaic effect arises from the properties of the p-n junction diode; as such there are no moving parts in a solar panel.

6.2 PHOTOVOLTAIC EFFECT

The Photovoltaic effect is the effect observed when electromagnetic radiation falls on a thin film of one solid deposited on the surface of a dissimilar solid producing a difference in potential between the two materials. The phenomenon in which the incidence of light or other electromagnetic radiation upon the junction of two dissimilar materials, as a metal and a semiconductor, induces the generation of an electromotive force. The conversion of electromagnetic radiation into electric power through absorption by a semiconducting material. Devices based on this effect serve as power sources in remote terrestrial locations and for satellites and other space applications. Photovoltaic-powered calculators and other consumer electronic products are widely available, and solar photovoltaic automobiles and aircraft have been demonstrated..

6.3 LEAD ACID BATTERY

After the conversion of solar energy into electrical energy, the energy has been sent to the Lead-acid Battery. The purpose of Lead-acid Battery is to store the energy for our requirements. Lead Battery is also known as Storage Battery.

6.4 PELTIER COOLER

The electrical energy generated by the solar panel has been sent to the Peltier plate present in the refrigerator. The electrical energy enters to the peltier plate/cooler (or) thermoelectric cooler; the function of peltier plate is to create heat flux between the junctions of two different types of materials. Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current and can be used either for heating or for cooling (refrigeration), although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools. In peltier plate, a voltage is applied across the device, and as a result, a difference in temperature will build up between the two sides. Thermoelectric coolers operate by the Peltier effect (which also goes by the more general name thermoelectric effect). The device has two sides, and when DC current flows through the device, it brings heat from one side to the other, so that one side gets cooler while the other gets hotter. The "hot" side is attached to a heat sink so that it remains at ambient temperature, while the cool side goes below room temperature. In some applications, multiple coolers can be cascaded together for lower temperature.

6.5 SOLAR PANEL

To find out how many amps solar panel will deliver in a full sunshine hour we need to do our calculations. We need to convert solar panel output watts to amp hours, so to find the amps we need to divide watts by volts.

$$I \text{ (amps)} = P \text{ (watts)} \div V \text{ (volt)}$$

6.5.1 CONVERSION OF ELECTRICAL ENERGY OF SOLAR PANEL PER HOUR

Current = watts/volts

$$I = W/V$$

$$= 10/5$$

= 2 amps per hour (on brilliant sunny day And the most likely average in usual weather would be closer to 3.4 amps per hour and we can maintain our battery power requirement between 2 and 3 hours.)

VII CONCLUSION

Solar energy is the best and abundantly available form of non-conventional energy source. We have developed a mini refrigerator which uses the solar energy and which has multi usage like heating and cooling. For heating or cooling purpose we are using peltier plate which works on the principle of peltier effect. This system has the advantage of fast chilling, as the plate heats just in the matter of seconds. This system eliminates the refrigerants, which are the main

source for the emission of CFC's and HCFC's which in turn reduces the GREEN HOUSE EFFECT and makes environment pollution free. This system is mainly applicable in preserving medicines, vaccines etc., especially in flood affected areas where there is no power supply.

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