

# DESIGN OF ENVIRONMENT FRIENDLY HANDMADE SOLAR REFRIGERATOR

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*Abstract: Nowadays the burning issue in the country is the deficiency of electricity in rural areas to provide required amount of cool environment to conserve specific kind of essential commodities. A possible remedy is to use fossil fuels on an average of 35% of the time. The generation of sufficient energy to fulfil the required needs may lead to significant operating costs and large volumes of greenhouse gas emissions. This paper presents a design of cooling refrigerator using solar energy. Under different types of cooling system, lithium-bromide (Li-Br) & water (H<sub>2</sub>O) is considered as the best pair for absorption coolant. In coolant (like water), there is zero ozone deficiency capacity and very little global warming potential. Thus, the proposed refrigerator is environmentally friendly. No moving parts are present in the system. The average insolation in India is more than 5.5 KW / m<sup>2</sup> per day, which is the most abundant, pollution-free source of such facilities. This paper therefore emphasizes the use of renewable energy sources such as solar energy in the cooling system.*

**Keyword:** Eco friendly Refrigeration, Energy Efficient refrigeration, Handmade refrigeration, Solar refrigeration,

## 1. INTRODUCTION

Power generation from fossil fuel is the leading cause of industrial air pollution in the country. Most of our electricity comes from coal, nuclear and non-renewable energy sources. The energy generated from these sources can cause serious harm our environment and pollute the air and land. Renewable energy sources can be used to generate electricity with minimal environmental impacts. Renewable energy can be generated from renewable energy sources without producing CO<sub>2</sub>.

Renewable energy is an energy that comes from natural sources that fill themselves up for a while without destroying the earth's resources. These resources are plentiful and almost always available in some capacity and they never cause environmental damage. Examples include solar, wind and thermal energy stored in the earth's crust. In comparison, fossil fuels like oil, coal, and natural gas are not renewable; their quantity on earth is reduced when we extract them, so we should stop using them as an economically viable source of energy. Although they are produced

by natural processes, these processes are very slow to replenish these fuels because humans use them, so these roots are lost sooner or later. Therefore, this project is developing a solar based mini refrigerator. This refrigerator is ideal for small-purpose refrigeration purposes and has a much shorter cooling time compared to regular refrigeration systems. For backup, the dynamo-based charging system along with this refrigerator allows the refrigerator to run smoothly in the absence of solar power.

Several analyses have been performed on the cooling method to cut back numerous capabilities connected issues. Author in this paper [1] have designed a compressor less solar energy and Peltier-based mini hand-made refrigerators, that facilitate preservation of essential drugs and limited amounts of drinking fluid. The analysis of this project can specialize in the system level cooling exploiting the peltier cooling system that involves peltier cooler modules, heat pipes and an air-cooled conductor. The elements of the hybrid system along with alternative cooling techniques, each active and passive, adopted in object cooling have been reviewed within the following sections. This technology has existed for about forty years. Several researchers are involved regarding the exploration of physical properties of the peltier material and its applications.

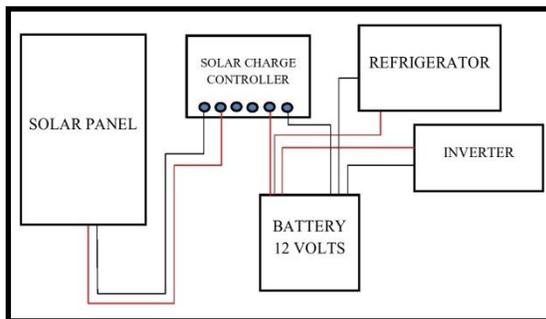
In another paper the author [2] enforced a nano science driven mini refrigerator that utilize peltier that results to refrigerate. Objective of this project is to produce thermoelectric refrigerator utilizing Peltier result to refrigerate and maintain a specific temperature, perform temperature management within the 5°C to 25°C. Interior cooled volume of 5 liter and retention for next 0.5 hour.

Researcher of this paper [3] enforced thermoelectricity driven refrigerator that is largely used for storing the drugs. This study demonstrates the practical implementation of waste energy recovery from high power density electronics in knowledge centers and server farms by means of the sensible and economic application of thermoelectricity. A summary of thermoelectricity and therefore the thermoelectricity effect is developed, together with a review of semiconductor materials and electronics cabinet cooling techniques. This report describes an investigation into the potency of application of thermoelectricity to reduced temperature waste heat things. Conclusions revealed regarding the potency of this application towards waste heat utilization for power recovery.

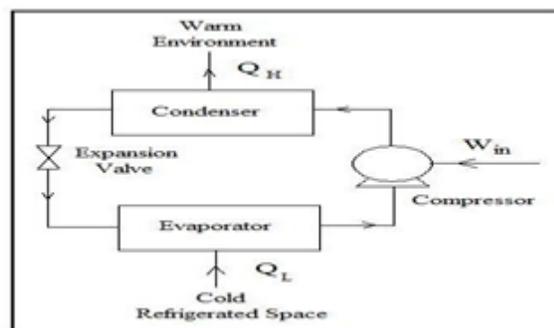
Researchers have made a brand-new type of refrigerator that needs a unique fashion of setup than the commercially usable refrigerators have. All of those technically enhance the projected parameters specific by the research worker. However, they are not going to use it in commercially available refrigerators, which may be one in all the burning problems once exchange these technologies with modern refrigeration method. In this paper the authors propose technology to implement their invention within the commercial refrigerators presently in use and expect that their methodology can improve the value potency in regard to alternative technologies.

## 2. PROPOSED DESIGN

An inverter refrigerator has been used as one of the key ingredients for proposed design. The power requirement is 300Watts for this refrigerator, though energy efficient refrigerators requires



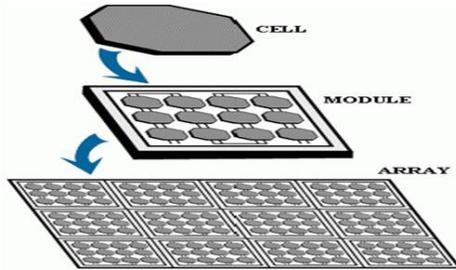
**Figure 2:** Circuit Diagram



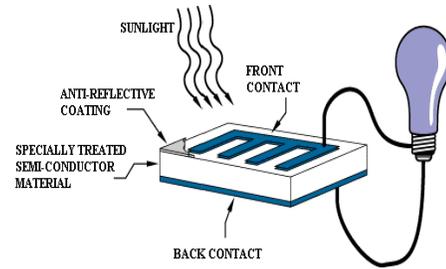
**Figure 1:** Vapour Compression Refrigeration Cycle

smaller size solar system. A refrigerator works on the vapor compression cycle as shown by Figure 2. The thermally insulated compartment and heat pump transfers the heat from inside of the refrigerator to external environment to maintain the temperature inside it to the set temperature which is below the normal room temperature.

A 500-Watt mono crystalline panel has been used to power up the refrigerator. Solar cells as shown by Figure 3, are manufactured from semiconductor materials like silicon. They are able to produce electric potential when photon energy from sunlight falls upon them. Usually, a single solar cell is very tiny and hence unable to produce the required energy to drive a refrigerator. Hence a group of solar cells are accumulated to produce a solar module and a group of solar modules is structured in a group of arrays to obtain a huge amount of energy.



**Figure 3:** Structure of Solar Panel [4]



**Figure 4:** Working of Solar Panel[4]

This electric energy produced by the group of solar cells, is connected to the load using electrical conductors as shown by Figure 4. Energy production from photo voltaic cell is very popular because of its green energy and its low cost. But it suffers from low efficiency during cloudy environment. Hence an auxiliary power source is also included in our design to reduce the problems during rainy seasons. Photo voltaic array is connected to the 12 Volt, 1500 ampere-hour battery through a charge controller. Charge controllers limits the rate of charging or discharging of connected battery and protects the battery from being overheated due to excessive charging. It also protects the battery from overvoltage. This kind of charge controller are usually a battery-operated electronic device that incorporates pulse width modulation technology and maximum power point tracker technology to adjust charging and discharging rates to provide maximum efficiency. Inverter has been incorporated in this design to convert the 12 Volt DC power obtained from the battery into 220 Volt AC power to run the refrigerator.

Setting the solar power ready for use of the refrigerator requires more devices than solar panel. Batteries are needed to store energy that we can use in the clouds are blocking the sun. Solar panels absorb the solar radiation and transfer it to the solar charger controller which helps to stream the power flow from the panels to the battery. The charge controller protects the battery from major power changes and ensures that it always receives appropriate current power. After passing through the battery and then to the inverter where the direct current (DC) supply is converted into an alternative current (AC) supply which is the main source home refrigeration use. The circuit diagram is shown in Figure 1.

The proposed design is therefore completed by connecting the solar panel and other associated components as per the connection diagram shown by Figure 1. The solar panel produces the rated 12 Volt DC voltage when the solar energy perpendicularly falls upon the solar panel. The charge produced by the solar panel transferred to the charge controller that takes

control over the charging and discharging of the battery connected to it. The output of the battery is connected to the inverter which converts the DC battery voltage of 12 Volt into 220 Volt AC signal to drive the refrigerator.

### 3. RESULT AND DISCUSSION

The purpose of developing the refrigerator is to provide efficient cooling. The authors have achieved to maintain a constant internal temperature of 16.5°C after 20 minutes of continuous power supply. When the battery is fully charged, the refrigerator stays active for up to 3.2 hours. When the battery is discharged completely, the temperature inside the refrigerator increases very slowly due to the presence of insulation.

The performance result of the proposed design ensures that the authors of this paper have achieved the required goal of designing a solar power refrigerator that can be used as small refrigerator for small to keep the ingredients inside below room temperature for small duration. Besides this, the system is provided with an easy to use solar panel charge controller for charging the battery from the solar panels. Additionally, a battery charger running on a standard 220 Volt AC supply is also provided, which is used to charge the batteries under cloudy environment.

### 4. COST ANALYSIS TABLE

Table 1- Cost Analysis Table

Sl. No.	Name of the Material / Equipment	Cost
1	Compressor (1Hp)	Rs. 3050
2	Condenser (Tube)	Rs. 1300
3	Filter/Dryer	Rs. 1500
4	Expansion Valve	Rs. 3100
5	Evaporator	Rs. 700
6	Accumulator Fan Motor	Rs. 500
7	Refrigerator Fan Motor	Rs. 1000
8	Freezer Fan Motor	Rs. 1000
9	Solar Panel (500 watts)	Rs. 6000
10	Batteries	Rs. 1500
11	Solar Charge Controller	Rs. 600
12	Insulation Material	Rs. 200
13	Wiring Material	Rs. 100
<b>Total</b>		Rs. 20550

## 5. CONCLUSION

Solar energy plays an important role to satisfy our nation's energy needs. It is growing rapidly and its applications are being explored in many areas. The proposed design of the refrigerator is meant to accomplish a little contribution towards the development of green energy driven equipment. The design still needs to be modified to provide more efficient and economical solution for rural areas of our country where population lives without electricity but need energy efficient refrigeration technology in conserving the medicines which are required to be kept in cool places under a specific temperature below the room temperature. This refrigeration technology can be applied to any commercially available refrigerator which is one of the key benefits that this design produces. Not only that, it can indirectly produce employment in terms of maintenance jobs for the local youth. Presently this refrigerator is less efficient than the refrigerator which runs on the non-renewable power sources. But with larger investment in solar power generation or using solar grids in the rural areas, the efficiency of refrigerator can be increased beyond expectation.

## 6. ACKNOWLEDGEMENT

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## REFERENCES

1. JB Horvay, "The Peltier Effect and Thermoelectric Transients", Doctoral Dissertation, University of Louisville, 1961
2. Mayank Awasthi, KVMali, "Design and Development of Thermoelectric Refrigerator", International Journal of Mechanical Engineering and Robotics, Vol. 1, No. 3, October, 2012.
3. B Jaspalsinh, "A Design Method of Thermo Electric Cooler", IJME, Vol. 5, No. 1, pp.37-40, 2012.
4. G. Knier, "How do photovoltaics work?", Science@ NASA story "The Edge of Sunshine", August, 2008