

# Solar Refrigerator

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**Abstract** - Solar energy is one of the most renewable energy sources with several benefits.[1] Solar power was chosen as an alternative energy source for this application because sunlight is a resource that coastal towns without an electricity infrastructure may use. The stool design is separated into three parts: cooling design, installation of energy sources, and linking to energy sources. Solar refrigeration refers to a refrigerator that runs on power generated by solar panels. Solar-powered dead refrigerators may become more widespread in the future generation. Today, the expanding interest and growing market for refrigeration.[2] Developing the world to help mitigate climate changes. It can't sist mainly two types rechargeable and non-rechargeable. This paper provides research about solar refrigerator and how it works.

**Key Words:** Solar Energy, Refrigerator, Utilized, Regeneration.

## 1. INTRODUCTION

Refrigeration is a procedure that involves moving something from one area to another. Solar refrigeration is a refrigerator that runs on electricity generated by solar energy. Solar power dead refrigerators may be most common in future generations developing the to help combat poverty and climate change.

• Solar Refrigeration System Types:

1. Rechargeable
2. non-Rechargeable
  - a) Photovoltaic refrigeration
  - b) Solar mechanical refrigeration
  - c) Absorption refrigeration

The refrigerant used is governed by the needed cooling temperature. Solar refrigeration is used to reduce energy consumption in places that are not linked to the electricity grid.

The impact on the environment and the cost of gasoline are two factors to consider. Energy consumption is increasing as the population and economy develop. The usage of fossil fuels will worsen the environment. Refrigeration and air conditioning are rising businesses as people's lifestyles change. They are also necessary for increasing the shelf life of fruits and vegetables, as well as storing certain medications and vaccinations. Refrigeration and air conditioning are rising businesses as people's lifestyles

change. They are also necessary for increasing the shelf life of fruits and vegetables, as well as storing certain medications and vaccinations. The Department of Health is concentrating on employing solar-powered refrigerators to keep vaccinations at the correct temperature for successful usage in remote parts of the Riau Islands. Recently, energy conservation and mitigating the effects of global warming have emerged as two of the world's most pressing issues. Because the amount of energy consumed by refrigeration systems in total energy consumption is continually growing, these systems are being researched. Recently, energy conservation and mitigating the effects of global warming have emerged as two of the world's most pressing issues. Thermomechanical, absorption, adsorption, and desiccant solutions are all part of solar thermal systems.[7]

As we all know, our fossil fuel supplies, such as coal and petroleum, are dwindling by the day. As a result, we are shifting towards renewable energy sources. Sun energy is one of the renewable energy alternatives that is abundant and may be used to generate power.

1. Provide a storage system (refrigerator) in rural areas when electricity is unavailable: There is an issue with electricity in rural areas. And without electricity, there were several issues, such as product storage. They are unable to preserve vegetables, medications that must be stored at temperatures below 8oC or 10oC, and so on. Only refrigeration, when powered by a solar PV panel, can meet the needs of rural residents for keeping products.
2. Provide a backup storage system at night: because there is no sunshine at night, producing power via solar panels is not viable. However, the problem is being remedied by storing coolness during the day using a battery. As a result, the second goal of the research is to keep the temperature below 15 degrees Celsius at night.[1]

## 2. DESIGN & DEVELOPMENT

The refrigeration device is made up of five parts: a solar cell, a solar charge controller, a battery, an inverter, and a refrigerator. As seen in Fig.1[1],

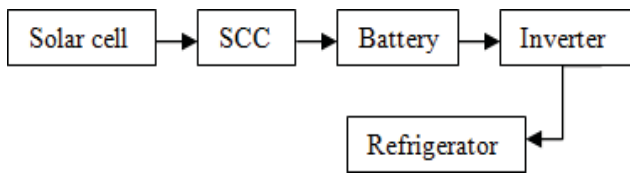


Fig. 1. System block diagram

- Refrigeration system is broadly classified into three types:

1. Photovoltaic operated refrigeration system

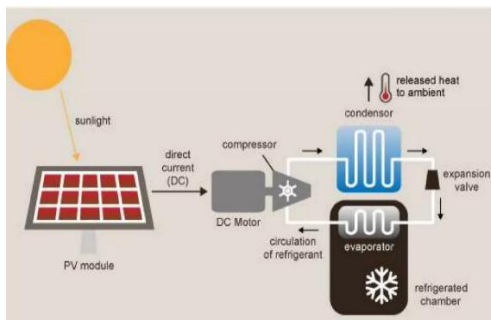


Fig. 2. Photovoltaic Operated Refrigeration System

Solar radiation is turned directly to direct current electricity in this technique utilizing semiconducting materials. The functioning of a solar refrigeration cycle driven by PV is straightforward. Solar photovoltaic panels generate direct current (DC) electrical power, which may be utilized to power a DC motor connected to the compressor of a vapor compression refrigeration system. The conversion of sunlight into DC electrical power, accomplished by the PV panel, allows for refrigeration. The compressor is powered by direct current and circulates refrigerant via a vapor compression refrigeration loop that removes heat from an insulated enclosure. The thermal reservoir and a phase transition substance are housed in this container.

2. Solar mechanical refrigeration

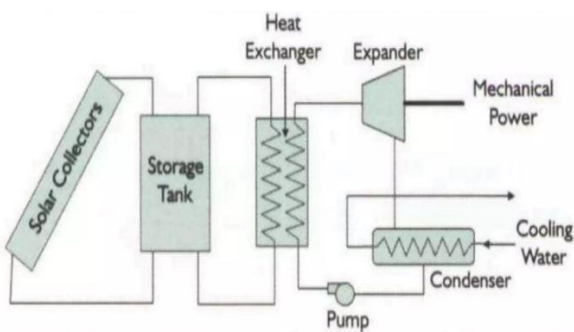


Fig. 3. Solar Mechanical Refrigeration

A solar Rankine cycle provides the needed compressor power to operate the compressor in the refrigeration cycle in this sort of refrigeration system. The solar panel absorbs sunlight, which powers a Rankine cycle and generates work in the turbine. This effort is then used to power the vapours compression refrigeration system's compressor.

3. Absorption refrigeration

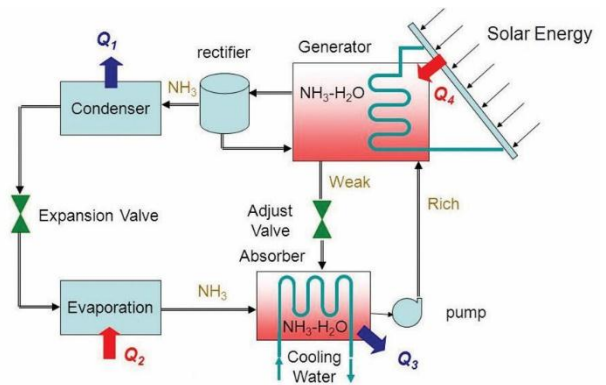


Fig. 4. Absorption Refrigeration

Absorption is the process through which a material transitions from one state to another. These two states form a strong attraction, resulting in a strong solution or combination. It is one of the earliest types of refrigeration technology. The first absorption system was developed in the 1700s. It was discovered that in the presence of H2SO4, pure H2O may be evaporated within an evacuated container to produce ice.[8] It cannot compete competitively with either traditional vapor compression or PV refrigerators.[6]

SOLAR REFRIGERATOR

A solar refrigerator is a cooling machine that uses solar thermal or photovoltaic energy from the sun to protect perishable goods from deteriorating. The sensor has a temperature range of 10 degrees Celsius.



Fig. 5. Solar Refrigerator

Solar collector absorption refrigerators employ a combination of water and lithium bromide (water- LiBr). With the decline of traditional energy sources and the rise of environmental contamination in the future, solar refrigeration systems will become increasingly popular. Solar refrigeration may be utilized in freezers, refrigerators, building air conditioning systems, food preservation, ice-making, and coolers, among other applications.

As a result, using solar energy may be a solution for meeting the ever-increasing energy demand. The anticipated scarcity of traditional energy sources such as fossil fuels, as well as the related negative environmental impact, are driving forces behind the use of solar energy. Refrigeration and air conditioning systems are among the best candidates for solar energy applications. Refrigeration is a technique that involves working on a system to shift heat from a lower temperature to a higher temperature in order to have a cooling effect. Refrigeration is used to keep a specific space's temperature lower than the surrounding environment. The mechanical device removes heat from the chilled compartment, which is kept at a lower temperature, and rejects it to the surrounding environment, which is kept at a higher temperature. It is also utilized to give comfort in hot and humid environments through the process of air conditioning. With the decline of conventional energy sources and the rise of environmental contamination in the future, it is projected that this sort of refrigeration system will be employed more and more. Solar refrigeration may be utilized in freezers, refrigerators, air conditioning systems in buildings, and food preservation.

### 3. SPECIFICATION OF COLD STORAGE CHAMBER

**Table.1 Specification of Cold Storage Chamber [3]**

Type of Cold Storage Chamber	Fabricated double wall chamber with composite insulation
Size of the chamber	0.50 m X 0.50 m X 0.50 m
Volume Capacity	125 Litres
Hinge door	0.30 m X 0.30 m X 0.038 m
Material to be stored	Any kinds of Perishable foods

### 4. SYSTEM DESCRIPTION

Under no load and full load situations, the solar photovoltaic refrigeration system was conceived and developed. To achieve the needed voltage and current, a PV panel comprised of three modules linked in series was employed. The refrigerator is powered by an alternate current-based compressor, similar to those used in standard residential refrigerators.[4]

**Table.2 System Description**

Sr.no.	Parameters	Specification
1.	Storage Capacity	20 Liters
2.	Door	Front Opening
3.	Type of Refrigeration	Vapor Compression Refrigeration
4.	Power Consumption	90W
5.	Refrigerant	R134a
6.	Operating Voltage	230V AC
7.	Maximum & Minimum Temperature	- 4°C
8.	Insulation	PUF

### 5. APPLICATIONS

- Solar energy should be given a chance if we want to protect the environment.
- Building air conditioning systems
- Food preservation
- Ice-Making
- Freezer's

### 6. RESULT

Solar refrigerators are helpful when there's no electricity or it's hard to get regular fuel. This means that it can be renewed or used again and again. Regular cooling systems release harmful gases that damage the environment.

### 7. CONCLUSION

Solar refrigeration system is the need of future. DC power refrigerators should be promoted in rural settings and clinical institutions like hospitals, also the refrigerator casing is not as air tight.[5] It is not too far that the world will face the scarcity of energy resources to satisfy the need of energy as well as the need of refrigeration. It has better matrices, size, cost, complexity of solar refrigeration system requires more size bulkiness, low operating cost, do not overweight, high initial investment etc.

### 8. FUTURE SCOPE

Solar refrigeration system will be used more and more with the decrease of conventional energy sources and the increase of environmental pollution in future. Solar-powered refrigerators are able to keep perishable goods such as meat and dairy cool in hot climates and are used to keep much-needed vaccines at their appropriate temperature to avoid spoilage.

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## 10. REFERENCES

- [1] Hajar, I., & Martianis, E. (2018). *Refrigerator Design Using Solar Energy. 2018 International Conference on Applied Science and Technology (iCAST)*. doi:10.1109/icast1.2018.8751629
- [2] Alahmer, A., & Ajib, S. (2020). *Solar cooling technologies: State of art and perspectives. Energy Conversion and Management, 214, 112896*. doi:10.1016/j.enconman.2020.112896
- [3] M, R., & Rathinam, A. (2018). *Effective power sharing between Solar Refrigerator and DC Micro Grid. 2018 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES)*. doi:10.1109/pedes.2018.8707802
- [4] Solar Refrigeration System Chamarthi S, Saxena A, Ratna S(2015) 2319-7064
- [5] Tsado, J., Mahmood, M. K., Raji, A. G., Usman, A. U., & Jiya, I. N. (2018). *Solar Powered DC Refrigerator with a Monitoring and Control System. 2018 IEEE PES/IASPowerAfrica*. doi:10.1109/powerafrica.2018.85211581109/PowerAfrica.2018.8521158
- [6] Review of solid adsorption solar refrigerator I: an overview of the refrigeration cycle. (2003). *Fuel and Energy Abstracts, 44(3), 160–161*. doi:10.1016/s01406701(03)81820910.1016/s01406701(03)81820-9
- [7] Kim, D. S., & Infante Ferreira, C. A. (2008). *Solar refrigeration options – a state-of-the-art review. International Journal of Refrigeration, 31(1), 315*. doi: 10.1016/j.ijrefrig.2007.07.011
- [8] Sarbu, I., & Sebarchievici, C. (2013). *Review of solar refrigeration and cooling systems. Energy and Buildings, 67, 286–297*. doi: 10.1016/j.enbuild.2013.08.02210.1016/j.enbuild.2013.08.022