

## SOLAR POWERED REFRIGERATION SYSTEM

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**Abstract— Solar energy is proved to be ideal source for low temperature heating application .Three known approaches that use solar energy to provide refrigeration at temperature below 0 degrees include PV operated refrigeration solar mechanical and compression refrigeration both PV operated and solar mechanical cycle relay on vapor compression refrigeration cycle where as compression refrigeration uses thermal energy as the primary input to the cycle .among this three approaches PV system is the most viable and appropriate means for small capacity portable system located in area not near conventional energy resources.**

**Keywords: Solarpanel, battery, compressor, condenser, evaporator .**

### I. INTRODUCTION

India is the largest producer of fruits and vegetables in the world scenario but the availability of fruits and vegetables per capita is significantly low because of Post Harvest losses which account for about 25 to 30 percent of production. Further, the quality of sizeable quantity of produces also deteriorates the moment it reaches the consumer. This happens because of perishable nature of the products. If consumption is not getting stabilized, the farmers switch over to other crops instead of going for one crop in the subsequent and cycle continues. Our farmers continue to remain poor even though they take risk to cultivate high value fruits and vegetables year after year. Introduction of Cold storage / Cold room facility will help them in removing the risk of distress sale and simultaneously will ensure better return.

The annual production of fruits and vegetables in the country accounts for 18 to 20 percent of our agriculture output[3]. Varied agro climatic conditions and better availability of package of practices, there is a vast scope for increasing the production. The lack of cold storage / cold room facilities is one of the main bottlenecks in tapping the potential. In Orissa the cold storage facilities are very less. The cold storages, which are available in the State, are mostly to store single commodity like potato, which results in poor capacity utilization.

### 1. NECESSITY OF COLD STORAGE IN INDIA

The financial condition of the farmers does not permit to establish a cold storage having capacity of 15 Tonnes

which is meant to store 150 quintals of the products in the cold storage which require crores of Rupees to establish it. The concept of cold room is to store vegetables, fruits and flowers for shorter duration for which a small and marginal farmer can store products for shorter period and sell it without deterioration of the product. Farmers will also get appropriate value of the product. It will reduce the distress sale. The farmers can establish cold rooms having 15 Tonnes capacity where the storing of surplus quantities may vary from 150 quintals. Since the investment of such cold room is low a farmer can easily establish a cold room to store his surplus product.

### 2. CONCEPT OF THE PROJECT

The capacity utilization in cold storage for fruits and vegetables is generally about 70 percent which is due to short storage life of the products and availability of products for storage throughout the year. Generally cold storage operates for 300 days in a year. The cold storage space of the proposed project shall be primarily used for storing fruits and vegetables for short duration storage of around 1-4 weeks[6]. Such cold storage facility would enable them to bargain for a better price of their produce at the bi-weekly /weekly wholesale market.

### 3. LITERATURE REVIEW

Many publications cover silicon photovoltaic panels (SPV panels) in several aspect and thus, only a moderately concise depiction of PV is got here. The sun panel is a semiconductor linked tool that straightforwardly changes day-light in electrical energy. It contains two semi-conducting equipment consisting a seam (Brendel. R., 1994a). PV results is a straight change of photons in electrical energy (electricity). In P type and N type materials (semiconductor) an event photon can be riveted and electrify an electron from the valence band-leaving gap after. In the simplest PV cell, these photo generated carries are separated by the field resulting from p-type and n-type doping in a p-n junction [10]. The energy band drawing of a single band-gap p-n junction cell demonstrate the PV effect. There are so many losses in apparatus.

The photo produced transporters rapidly thermalize to the border of the band-gap losing energy in surplus of band-gap. Some of the transporters recombine either radioactivity emitting a photo or non- radioactivity for instance via impurity conditions. They also exist when the transporters transverse the losses junction and at the

contacts. The utilizable energy ( $q.v$ ) is, therefore, significantly lesser than the energy of the incident photon and also lesser than the band-gap. Hence the photons with the power larger than band-gap are riveted raising the electron hole pairs. Generation of voltage by the light incidence up, the semiconductor materials system is known as photovoltaic [11]. There are three main processes responsible for photovoltaic effect.

- Absorption of light in the semiconductor to create transporters.
- Separation and collection of these charges by an internal field.
- Distribution of these charges via an external lead.

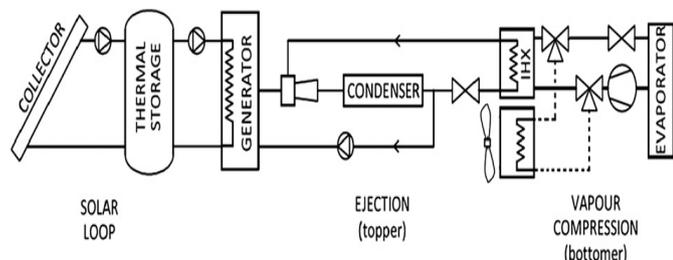
### 3.1 Traditional vapour compression cycle

The bottomer vapour compression cycle is simulated by deter-mining fluid states at the main location in the circuit: compressor inlet, condenser inlet, condenser outlet and evaporator inlet. No pressure drops or thermal losses were assumed, and the compressor isentropic efficiency was set constant and to a value of 0.6. The operating fluid is R134a and a constant mass flow of 80 g/s was assumed. Performance maps were obtained by solving the resulting equation array numerically, in terms of thermal power discharged at the condenser, cold delivered at the evaporator and power absorbed by the compressor.

### 4.Methodology

In order to implement a numerical model to simulate the cascade system (layout in Fig. 1), three steps were undertaken. In the first place, a commercial equation solver was used to characterise the performance of an ejection refrigeration cycle. The performance of such cycle was mapped as a function of generator, evaporator and condenser temperature. As a second step, the performance of a traditional vapour compression cycle were obtained by means of a numerical simulation and coupled to the ejector performance maps in order to predict the behaviour of the cascade system with varying generator and ambient temperature.

Finally, a transient simulation model including solar collectors, thermal storage and load was developed in order to evaluate the year-round performance of the cascade system when employed in a realistic scenario.



### 5 . REQUIREMENT OF COOLING SYSTEM

In India 70 percent population depend on Agriculture [4]. Upliftment of those categories can improve the overall status of the State. Comparing the developed States of our country, the economic condition of farmers of our State is miserable. The economic condition of most of the people is poor out of the total farmers about 47 to 48 percent of people cultivate cabbage, beans, onion, sweet

potato , Brinjal, pea etc which has a very limited period [5] . Similarly the fruits have also limited life after harvest. Post Harvest cooling rapidly removes held heat, reduces respiratory - activity, reduce internal water, wilting, slow the growth of micro organism and reduces the production of natural ripening agent i.e. ethylene Post Harvest cooling also provides marketing flexibility by allowing the grower to sell produce at the most appropriate time. Unavailability cooling and storage facilities makes it necessary to market the produce immediately after harvest and may result undistress sale. This can be an advantageous to growers who supply products restaurants and grocery stores or to small growers who wait to assemble truck load for transportation to other place. Post Harvest cooling can be an active tool to deliver highest qualitative produce to the consumer. Intervention through Post Harvest cooling will help the farmers to store their produces and market them at the opportune time.

### #.Working of vapor compression Refrigeration System-

#### a. Solar Panel

1. Location
2. Weather  
Clear, sunny skies better than cloudy skies  
Temperature not critical for well designed installations
3. Direction solar arrays  
face South preferred, east and west acceptable
4. Absence of shade Trees, Flatirons, etc.
5. Latitude  
Lower latitudes better than higher latitudes The sun rays are emitted on solar panel then electricity is generated.
6. The electricity for heating coil is obtained from the solar panel.
7. The solar panel used in the project is of 60W and 4A.
8. Usually made up of p-n silicon semiconductors,

Number of Amp/Hours used Per day*	8
Number of Hours of Direct Sunlight per day	6
Minimum Watts Required	360
Recommended Panel Size (add 20%)	432

9. Aluminum or fiber glass. Fiber glass is widely used selection of solar panel

#### Condenser

1. A device or unit used to condense a substance from its gaseous to its liquid state.
2. Application areas include air conditioning, industrial chemical processes such as distillation, steam power plants and other heat-exchange systems.

### c. Expansion Valve

1. Controls the amount of refrigerant flow into the evaporator .
2. Cause a pressure drop (Isenthalpic) of the working fluid.
3. Type of expansion valves used capillary type expansion valve.

### d. Evaporator

1. Absorption of heat from the surrounding.
2. Heat transfer is done by forced convection or natural convection.
3. Application areas : food and beverage industry, pharmaceutical industry.

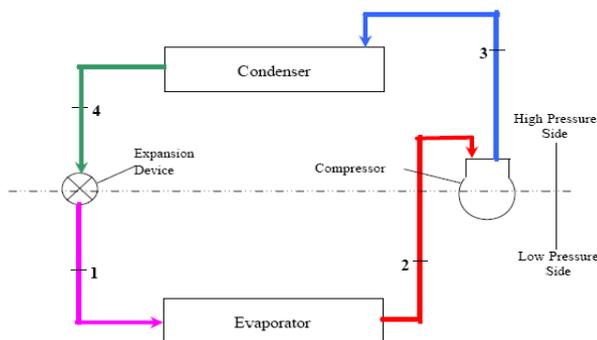


Figure 1. Refrigeration System

## 6. CONCLUSION

An investigation into the refrigeration solution for agriculture in India has been made using deductive reasoning based on evidence and easy case study to arrive at the best possible approach for holistic development of the cold chain. Heat driven refrigeration cycle where demand most appropriate for the India due to high solar isolation level throughout the country.

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